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WESTERN SPRUCE BUDWORM OUTBREAK HISTORY IN SOUTHWESTERN MIXED CONIFER HABITAT TYPES

by
Thomas W. Swetnam

Western Spruce Budworm Outbreak History

In

Southwestern Mixed Conifer Habitat Types

Final Report

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INTRODUCTION

Forest entomologists and ecologists have observed that site and tree characteristics influence forest stand susceptibility and vulnerability to western spruce budworms, *Choristoneura occidentalis* Freeman (Carlson et al. 1983, Fellin et al. 1983). These characteristics include tree species composition, stand density, height structure, tree vigor and maturity, macro- and micro-climate, and surrounding forest types. The "habitat type" plant community classification scheme (Moir and Ludwig 1979, DeVelice et al. 1986) reflects a number of these characteristics, particularly species composition and climatic factors. Previous tree-ring investigations in the Southern Rockies have shown that changes in budworm outbreak regimes have probably occurred in the twentieth century relative to earlier centuries, and these changes were hypothesized to have resulted from human-caused changes in stand structure and composition (Swetnam and Lynch 1989).

This study sampled and dendrochronologically analyzed an expanded set of twenty southwestern mixed-conifer habitat types in northern New Mexico that have been subject to episodic western spruce budworm defoliation. Objectives were to test the relations between stand structure, composition, habitat type and temporal changes in budworm outbreak regimes. Tree-ring samples from host trees were used to reconstruct the history of budworm outbreaks during the past several centuries, and to compare the frequency and severity of these outbreaks among different watersheds in northern New Mexico.

PRODUCTS

This project was originally funded jointly under a contract (No. 28-K7-406) and a cooperative agreement (No. 28-C6-392). A final report was delivered for the contract in January 1989. That report contains detailed descriptions of sampling procedures, as well as a tables and graphics listing the stand measurements (basal area/ha, stems/ha by tree species) for all sampled stands. Tree-ring chronology development and analyses completed up to that time

were described and data listings of corrected tree-ring chronologies were included in an appendix. A preliminary assessment of relations between outbreak history and habitat types was also presented.

Since the preparation of the 1989 report all collections from 20 mixed conifer stands have been dated, measured, and dendrochronologically analyzed. In addition to the 20 mixed conifer stands 9 stands of non-host species (ponderosa pine and limber pine) were sampled and analyzed. Four other paired tree-ring collections from mixed conifer and pine stands from the northern New Mexico from previous studies (Swetnam and Lynch 1989) have been combined with the new data set. This total collection comprises tree-ring chronologies from approximately 1,250 trees and well over one half million annual ring measurements. This is a very large and valuable data set that we expect will provide us with a wide variety of new insights into western spruce budworm history and forest dynamics. Most of the resources of this project have gone into the very arduous process of collection, preparation, and development of the database.

This purpose of this report is to deliver the fundamental data products of this research work to Rocky Mountain Forest and Range Experiment Station (RMFRES) - namely the tree-ring chronologies and stand measurement data and the first manuscript describing results that will be submitted to a peer reviewed journal. These data are included as appendices B (standard chronologies), C (corrected host tree chronologies). A draft manuscript that describes temporal and spatial patterns of these data sets is included as appendix A. This manuscript contains a table listing the stand measurement data (site characteristics, stems/ha, basal area/ha by tree species). We plan to revise this manuscript following receipt of comments from an "in-house" review at RMFRES and the Laboratory of Tree Ring Research and then its will be submitted to Canadian Journal of Forest Research.

The large database of budworm outbreak history and stand measurements provides material that will be used in a variety of manuscripts submitted to peer-reviewed journals.

Papers in preparation from analyses of the tree-ring and stand data are listed below. These papers will developed in collaboration with and co-authored by Dr. A. M. Lynch of RMFRES. Dr. Lynch has also proposed to prepare a set of Forest Service publications detailing budworm outbreak histories and impacts on National Forests in Colorado and New Mexico that will draw from the data obtained in this study. Dr. T. W. Swetnam will collaborate and co-author on these manuscripts.

1. Relations Between Western Spruce Budworm Outbreak History and Southwestern Habitat Types. Preliminary data for this paper were presented in the Final Report for Contract No. 28-K7-406. Additional analysis on remaining sampled stands is underway.
2. Western Spruce Budworm-Caused Mortality Patterns in Southwestern Mixed Conifer Forests: Evidence From Dendrochronology. Preliminary data from these analysis were reported in Final report for Contract No. 28-K7-406.
3. Millennia-length Spring-Summer Precipitation Reconstruction from Ancient Limber Pines in North Central New Mexico. Exceptionally long and high quality dendroclimatic reconstructions using material collected during this project have been obtained, and a manuscript is in preparation.
4. Effects of Mistletoe on Radial growth of Defoliated Douglas-fir and White Fir

Possible journals for papers 1, 2, and 4 include Forest Science, Forest Ecology and Management, Ecological Applications, and Canadian Journal of Forest Research. Possible journals for paper no. 3 are Science, Nature, Climate Change, Journal of Climate.

Other Products

Results of this research have been presented, and are scheduled to be presented, at several symposia and workshops:

Western Forest Insect Work Conference, March 1988, Flagstaff AZ, and March 1991 Denver, CO. Workshops were presented on historical patterns of budworm outbreaks derived from tree-rings. Abstracts published in proceedings.

Southwest Biodiversity Symposium, July 1990, Las Cruces NM. Invited presentation given to managers and scientists on role of budworms and fire in structuring of presettlement Southwestern forests.

Society of American Foresters annual meeting, August 1991, San Francisco. Invited presentation - A. M. Lynch and T. W. Swetnam, "Dendrochronologic History of Western Spruce Budworm in New Mexico and Colorado", Abstract published in proceedings.

Simposia Nacional sobre Parasitologia Forestal, October 1989, Juarez, Mexico. Invited presentation, "Investigations of *Choristoneura occidentalis* in the Southwestern United States, with Special Reference to Dwarf Mistletoe Applications and to Dendrochronology. A. M. Lynch, F. G. Hawksworth, and T. W. Swetnam. Paper published in proceedings.

LITERATURE CITED

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APPENDIX A

Douglas-Fir and White Fir

Standard Tree-Ring Chronology Listings

These are standard mean ring-width chronologies from all mixed conifer sites sampled during this project. These chronologies are included in magnetic form in a Quattro Pro spreadsheet file called "ALLNEW.WQ1".

YEAR	POLDF	POLWF	FLEDF	FLEWF	LAJDF	LAJWF	ALADF	ALAWF	BARDF	BARWF	EFKDF	EFKWF	LEFDF	LEFWF	LOGDF	LOGWF	WVADF	WVAWF	PEHDF	PEHWF	FWNDF	FWNWF	REDDF	REDWF	BONDF	BONWF	SRRDF	SRRWF	RTCDF
1600																									0.823				0.869
1601																									0.812				0.445
1602							1.177																		1.258				1.609
1603							1.771																		1.351				1.614
1604							1.413																		1.398				1.774
1605							1.076																		1.095				1.041
1606							1.005																		1.021				0.628
1607							0.854																		1.015				0.678
1608							1.130																		1.141				1.221
1609							1.004																		0.885				0.661
1610							0.789																		1.136				1.174
1611							0.731																		0.952				0.934
1612							0.619																		0.856				0.782
1613							0.586																		0.79				1.073
1614							0.880																		0.774				0.918
1615							1.132																		0.915				1.037
1616							0.826																		0.695				0.764
1617							0.850																		0.747				0.763
1618							0.939																		0.778				1.109
1619							1.234																		0.905				0.969
1620							1.279												0.953						1.159				0.917
1621							1.560												1.075						0.994				0.855
1622							1.405												1.16						0.956				0.563
1623							1.325												1.246						1.142				1.159
1624							1.118												1.193						0.936				0.512
1625							0.791												1.382						0.641				0.412
1626							0.985												1.29						0.918				0.727
1627							1.141												1.13						0.896				1.167
1628							1.147												1.291						0.854				0.890
1629							0.907												1.264						1.286				1.594
1630							1.269	2.148											0.985						1.468				1.586
1631							1.277	0.045											0.89						1.019				0.604
1632							1.199	1.273											0.952						1.139				0.706
1633							1.206	1.704											1.378						1.151				1.223
1634							1.381	2.047											1.329						1.098				1.377
1635							1.648	1.567											1.059						0.997				1.371
1636							1.760	1.559											1.315						1.009				1.382
1637							1.721	1.843											1.259						1.123				1.382
1638							1.599	1.261											0.888						0.788				0.413
1639							1.432	1.140											0.794						0.971				1.603
1640							1.525	1.143											0.971						1.222				1.552
1641							1.248	0.832											0.869						0.834				0.398

YEAR	POLDF	POLWF	FLEDF	FLEWF	LAJDF	LAJWF	ALADF	ALAWF	BARDF	BARWF	EFKDF	EFKWF	LEFDF	LEFWF	LOGDF	LOGWF	WVADF	WVAWF	PEHDF	PEHWF	FWNDF	FWNWF	REDDF	REDWF	BONDF	BONWF	SRRDF	SRRWF	RTCDF
1642							0.990	0.843											0.93						0.886				0.957
1643							1.092	0.988											1.026						0.958				0.925
1644							1.176	0.960											0.855						1.043				1.062
1645							0.494	0.332											1.002						0.679				0.104
1646							1.136	0.728											0.992						1.168				1.426
1647							1.379	1.070											0.833						1.096				1.059
1648							0.943	0.891											0.889						1.071				0.766
1649							1.065	0.933											0.848						1.052				1.230
1650							1.225	0.825											0.816						0.8				0.831
1651							1.428	1.188											0.719						1.202				1.115
1652							1.564	1.720											0.535						0.945				1.224
1653							1.607	1.988											0.528						1.275				1.290
1654							1.029	1.180											0.664						0.742				0.138
1655							1.438	1.597											0.828						1.205				1.920
1656	0.697						1.242	1.167											0.71						0.884				1.243
1657	1.025						1.142	1.224											0.661						1.016				1.704
1658	1.040						0.922	0.700											0.676						0.784				0.802
1659	0.680						0.835	0.797											0.899						0.865				1.218
1660	0.878						0.954	0.955											0.695						1.029				1.473
1661	0.829						1.152	1.328											0.79						1.108				1.368
1662	0.659						1.201	1.148											0.543						1.011				0.868
1663	0.595						1.123	0.977											0.495						1.066				0.980
1664	0.490						0.850	0.872											0.439						0.87				0.862
1665	0.820						0.902	1.084											0.429						0.901				0.934
1666	0.508						0.761	0.717											0.462						0.744				0.233
1667	0.717						0.902	0.839											0.455						0.801				0.871
1668	0.446						0.636	0.640											0.474						0.615				0.265
1669	0.493						0.621	0.736											0.499						0.621				0.501
1670	0.356						0.703	0.755											0.597						0.855				0.874
1671	0.609						0.885	1.122											0.581						1.117				0.784
1672	0.816						0.814	1.063											0.79						1.015				0.605
1673	0.627						0.704	0.895											0.797						1.012				0.873
1674	1.019						0.861	1.136											0.729						0.971				1.082
1675	0.867						0.925	1.032											0.77						0.831				0.347
1676	1.193						1.061	1.378											0.717						1.069				0.852
1677	1.259						1.334	1.596											0.787						0.864				1.071
1678	1.704						1.353	1.690											0.807						1.039				1.732
1679	1.206						1.152	1.208											0.764						0.84				0.700
1680	1.383						1.062	1.440					0.855						0.839						0.853				1.566
1681	1.202						0.858	0.921					0.923						0.706						0.692	0.716			0.634
1682	1.557						1.033	1.596					1.105						0.769						0.75	0.851			0.790
1683	1.557						1.045	1.523					1.165						0.83						0.771	0.942			0.998

YEAR	POLDF	POLWF	FLEDF	FLEWF	LAJDF	LAJWF	ALADF	ALAWF	BARDF	BARWF	EFKDF	EFKWF	LEFDF	LEFWF	LOGDF	LOGWF	WVADF	WVAWF	PEHDF	PEHWF	FWNDF	FWNWF	REDDF	REDWF	BONDF	BONWF	SRRDF	SRRWF	RTCDF
1684	0.776						0.515	0.897					0.888						0.777						0.824	0.805			0.631
1685	0.489				0.996		0.428	0.837					0.309						0.534						0.263	0.556			0.217
1686	1.090				0.799		1.062	1.388					0.866						1.132						0.901	0.869			0.767
1687	1.505				0.465		1.065	1.641					0.957						1.046						0.888	1.033			1.018
1688	1.268				0.456		1.115	1.530					1.093						0.83						1.236	1.046			1.241
1689	2.056				0.951		1.422	1.946					1.196						1.006						1.343	1.238			1.674
1690	1.662			0.935	1.150		1.372	1.479					1.269						1.159						1.244	0.96			1.198
1691	1.245			0.994	0.617		0.966	0.917					0.998						1.422						1.08	1.009			0.916
1692	2.168			0.826	1.063		1.290	1.325					1.285						1.754						1.252	1.235			1.544
1693	1.772			0.650	0.991		1.136	1.033					1.364						1.93						1.34	0.982			1.853
1694	0.960			0.480	0.805		0.760	0.595					0.938						2.026						0.876	0.671			0.505
1695	1.183			0.699	0.981		0.872	0.672					1.093						2.073						0.874	0.788			1.064
1696	0.595			0.997	0.438		0.609	0.432					0.504						1.783						0.669	0.578			0.455
1697	1.656			1.290	0.915		1.141	0.798					0.966						1.912						0.847	1.121			1.580
1698	1.466			1.067	1.099		1.023	0.709					0.738						1.789						0.901	0.856			1.017
1699	1.343			1.481	0.937		1.149	0.864					0.824						1.769						1.05	1.348			1.342
1700	1.004			1.187	0.406		0.861	0.679					0.669						1.832						0.895	1.092			0.734
1701	1.364			1.707	0.897		1.167	0.933					1.242						1.648						1.156	1.365			1.763
1702	0.927			1.400	0.564		0.997	0.694					0.988						1.836						1.054	1.201			0.945
1703	1.611			1.417	0.902		1.449	1.218					1.253						2.882						1.285	1.045			1.605
1704	0.978			1.212	0.725		1.052	0.932					0.717						2.335						1.194	1.109			0.787
1705	0.710			0.864	0.413		0.867	0.788					0.877						2.132						0.911	1.535			0.480
1706	1.610			0.913	1.164		1.415	1.417					1.357						1.927						1.072	1.749			1.564
1707	0.914			1.070	0.679		0.758	0.581					1.345						1.863						1.128	1.257			0.676
1708	1.367			1.368	0.978		1.095	1.209					1.397						1.855						1.131	1.427			1.144
1709	0.807			1.259	0.591		0.875	1.031					1.047						1.237						0.989	1.142			0.505
1710	1.917			1.430	1.319		1.237	1.376					1.379						0.586						1.29	1.901			1.774
1711	1.335			1.495	1.716		1.050	0.875					1.182						1.57						1.147	1.577			1.245
1712	1.310			1.930	1.656		1.286	1.090					1.089						1.015						1.091	1.694			1.203
1713	1.051			1.645	1.874		0.988	0.909					1.288						0.936						1.268	1.742			1.365
1714	0.549			1.095	1.352		0.587	0.530					0.768						1.02						1.131	1.203			0.822
1715	1.013			1.036	1.225		0.748	0.614					0.766						1.1						0.957	0.986			0.573
1716	0.443			1.060	0.588		0.409	0.341					0.532						0.347						0.652	0.517			0.245
1717	0.479			1.240	1.074		1.052	1.066					0.962						0.261						0.938	0.792			0.765
1718	0.563			1.227	1.247		0.994	0.934					1.031						0.403						0.934	1.025			1.104
1719	0.324			0.889	0.415		0.627	0.634					0.642		0.762				0.551						0.701	0.875			0.511
1720	0.873			1.566	1.367		0.969	1.197					1.539		1.004				0.765						0.971	1.617			1.280
1721	1.382		1.108	1.804	1.669		1.255	1.272					1.757		0.883				0.898						0.852	1.521			1.061
1722	1.413		0.815	1.193	1.555		0.892	0.821					1.654		0.927				1.002						0.702	1.28			1.058
1723	0.787		0.786	0.885	1.053		0.774	0.827					1.527		0.743				1.166						0.664	1.327			0.854
1724	0.849		1.074	1.565	1.426		0.692	0.719					1.041		1.151				1.364						0.767	1.442			0.789
1725	0.590		0.803	1.225	1.054		0.679	0.749					1.47		1.321				0.796						0.682	0.911			0.661

YEAR	POLDF	POLWF	FLEDF	FLEWF	LAJDF	LAJWF	ALADF	ALAWF	BARDF	BARWF	EFKDF	EFKWF	LEFDF	LEFWF	LOGDF	LOGWF	WVADF	WVAWF	PEHDF	PEHWF	FWNDF	FWNWF	REDDF	REDWF	BONDF	BONWF	SRRDF	SRRWF	RTCDF
1726	1.316		1.069	1.327	1.963		1.188	1.197					1.619		1.137				0.114						1.279	1.858			2.076
1727	1.103		0.706	1.132	1.279		0.853	0.853					1.299		0.971				0.32						1.004	1.098			1.176
1728	0.844		0.661	1.180	0.959		0.880	0.958					0.92		1.079				0.673						0.776	1.118			0.710
1729	0.106		0.464	0.626	0.235		0.155	0.099					0.201		0.756				0.618						0.461	0.326			0.132
1730	0.638		1.043	0.979	0.259		0.531	0.543					0.5		0.967				0.465						0.62	0.832			0.608
1731	1.178		1.372	1.250	0.474		0.711	0.725					1.113		1.189				0.754						0.785	1.224			0.774
1732	1.205		1.297	1.095	0.617		0.890	0.909					1.408		1.22				0.913						0.918	1.331			0.849
1733	0.411		0.710	0.738	0.199		0.432	0.280					0.86		1.169				1.175						0.781	0.748			0.364
1734	1.103		1.162	1.231	0.663		1.034	1.121					1.279		1.185				1.269						1.031	1.392			1.220
1735	0.609		0.850	0.888	0.300		0.793	0.671					0.364		0.96				1.293						0.672	0.655			0.394
1736	0.629		0.958	1.265	0.344		1.009	0.801					0.894		0.904				0.788						1.111	1.698			1.369
1737	0.211		0.737	0.796	0.212		0.437	0.279					0.454		0.678				0.723						0.707	0.867			0.521
1738	0.584		0.899	0.944	0.130		0.528	0.427	1.239				0.329		0.915				0.89						0.52	0.45			0.246
1739	0.743		0.977	0.790	0.369		0.789	0.624	0.558				0.555		0.731				1.046						0.95	1.205			0.929
1740	0.703		0.921	1.112	0.326		0.706	0.578	0.416				1.114		0.772				0.689						0.907	0.885			0.780
1741	0.807		0.722	0.916	0.446		0.860	0.732	0.329				1.153		1.062				0.927						0.852	0.824			0.544
1742	0.930		0.645	0.931	0.515		0.872	0.709	0.863				1.194		0.769				0.895						1.012	0.685			0.652
1743	1.445		1.387	1.458	0.704		1.260	1.115	0.551				1.203		0.885				1.019						1.269	1.18			1.474
1744	1.299		1.195	1.139	0.727		1.136	0.844	1.195				1.177		0.957				1.231						1.072	0.676			0.821
1745	1.228		0.915	1.074	0.818		1.348	1.121	1.053				0.762		0.872				1.031						0.866	0.63			0.964
1746	1.650		0.962	1.366	1.371		1.280	1.367	0.819				1.118		1.029				1.002					2.041	1.058	1.231			1.532
1747	1.671		1.313	1.282	1.379		1.402	1.314	1.004				1.422		1.034				0.969					1.933	1.063	0.768			1.357
1748	0.341		0.601	0.398	0.501		0.332	0.192	0.884				0.517		0.756				0.567					1.404	0.649	0.342			0.556
1749	1.186		1.004	1.097	1.085		0.933	0.975	0.506				1.24		1.132				0.973					1.190	0.865	0.88			1.264
1750	0.461		0.813	0.766	0.338		0.522	0.444	1.149				0.943		1.237				1.175					1.020	0.729	0.463			0.679
1751	1.028		1.171	1.177	0.820		1.181	1.221	0.803				1.229		1.197				1.303					1.279	1.102	1.037			1.630
1752	0.309		0.590	0.255	0.307		0.523	0.344	0.856				0.227		0.777				1.286					1.266	0.611	0.499			0.252
1753	0.753		0.871	0.782	0.596		0.947	1.012	0.472				1.085		0.815				1.112					1.380	0.868	0.591			1.380
1754	1.001		1.088	1.090	1.041		1.086	1.053	0.652				0.95		0.924				1.249					1.275	1.048	0.615			1.535
1755	1.080		1.151	1.300	1.070		1.181	1.187	0.909				0.945		0.941				1.397					1.416	1.183	0.491			1.826
1756	0.905		0.806	0.707	0.949		0.917	0.770	0.853				0.668		1.003				1.206	1.374				1.423	1.039	0.394			1.028
1757	0.881		0.886	0.735	0.855		0.710	0.809	0.711				0.399		1.171				1.17	1.182				1.935	1.284	0.638			1.635
1758	1.140		1.356	1.004	0.910		1.230	1.285	0.86				0.787		1.121				1.258	1.436				1.418	1.147	0.491			1.154
1759	1.279		1.271	1.100	1.209		1.373	1.350	0.812				0.758		1.147				1.329	1.518				1.281	0.909	0.409			0.977
1760	1.109		0.921	0.836	0.992		1.117	1.167	0.842				0.453		1.003				1.181	1.377				1.255	1.004	0.39	0.878	0.539	0.935
1761	1.297		1.509	1.147	1.888		1.469	1.477	1.133				0.678		1.088				1.157	1.591				1.683	1.014	0.497	1.128	0.881	1.691
1762	1.277		1.126	1.171	2.021		1.435	1.267	1.173				0.985		0.942				1.08	1.045				1.415	1.21	0.3	1.101	0.955	1.390
1763	0.971		0.741	0.669	1.220		0.891	0.723	0.975				0.584		0.883				0.962	1.2				1.307	1.047	0.352	0.89	0.881	0.857
1764	0.965		1.175	0.999	1.807		1.294	1.344	1.121				1.415		1.036				1.104	1.087				1.377	1.025	0.319	0.944	0.926	1.431
1765	0.827		1.049	0.634	1.559		1.209	0.941	1.205				1.378		1.037				1.039	1.073			1.678	1.140	0.833	0.238	0.97	0.92	0.783
1766	1.044		1.356	0.984	1.998		1.536	1.385	1.78				1.274		1.114				1.077	0.997			1.805	0.956	1.147	0.355	1.325	1.131	1.843
1767	0.916		1.026	0.775	2.203		1.493	1.272	1.162		0.781		1.104		0.947				1.106	0.858			1.363	1.102	1.023	0.262	1.305	1.185	0.975

YEAR	POLDF	POLWF	FLEDF	FLEWF	LAJDF	LAJWF	ALADF	ALAWF	BARDF	BARWF	EFKDF	EFKWF	LEFDF	LEFWF	LOGDF	LOGWF	WVADF	WVAWF	PEHDF	PEHWF	FWNDF	FWNWF	REDDF	REDWF	BONDF	BONWF	SRRDF	SRRWF	RTCDF
1768	0.746		0.948	0.982	2.655		1.346	1.244	1.059		0.567		1.452		0.869			1.521	0.841	0.822			1.545	0.699	1.005	0.268	1.208	1.051	1.555
1769	0.607		0.901	0.952	1.774		1.088	1.184	1.064		0.726		1.46		0.931			1.54	0.908	0.938			1.612	0.775	0.878	0.262	1.064	1.065	1.241
1770	0.575		0.926	1.012	2.108		1.123	1.214	0.96		0.631		1.387		1.009			1.559	1.244	1.003			1.264	0.981	0.924	0.429	1.036	0.974	1.238
1771	0.719		1.451	1.184	2.079		1.426	1.565	1.501		0.754		1.851		1.115			1.544	1.157	1.009			1.454	0.891	0.927	0.404	1.027	1.071	1.637
1772	0.620		0.681	0.758	1.415		0.954	1.046	0.977		0.69		1.301		0.859			1.092	0.884	0.77			0.828	0.750	0.858	0.319	0.851	0.954	1.100
1773	0.410		0.860	0.374	0.867		0.534	0.535	0.367		0.434		0.329		0.503			0.375	0.651	0.48			1.131	0.688	0.651	0.188	0.658	0.6	0.867
1774	0.541		0.856	0.828	0.844		0.753	0.942	0.931		0.734		0.805		0.788			0.953	0.57	0.213			1.196	0.830	0.633	0.241	0.876	0.701	0.698
1775	0.572		0.600	0.592	1.073		0.643	0.721	0.898		0.863		0.73		1			0.655	0.727	0.421			0.683	0.765	0.569	0.345	0.91	0.925	0.524
1776	0.695		0.943	0.928	1.141		0.915	1.064	1.357		0.873		0.771		1.015			1.305	0.576	0.566			1.095	1.510	0.627	0.405	1.067	1.009	1.015
1777	0.682		0.753	0.678	0.963		0.945	1.000	0.906		0.872		0.66		1.086			0.766	0.661	0.796			1.003	1.366	0.647	0.305	1.016	1.003	0.850
1778	0.625		0.727	0.633	0.614		0.849	0.840	1.051		0.989		0.84		1.261			1.187	0.94	0.964			0.790	1.216	0.79	0.394	0.867	0.862	0.505
1779	0.849		0.842	0.705	1.009		0.864	0.948	0.886		0.864		0.603		1.061			1.165	0.924	0.884			0.743	1.128	0.564	0.336	0.71	0.631	0.405
1780	0.626		0.617	0.490	0.536		0.544	0.622	0.71		0.832		0.502		1.004			0.742	0.875	0.92			0.646	0.792	0.445	0.273	0.77	0.835	0.465
1781	0.622		0.772	0.485	0.498		0.469	0.553	1.075		0.943		0.643		1.132			0.774	0.968	1.239			0.699	0.856	0.537	0.364	0.776	0.951	0.424
1782	1.097		1.364	0.614	0.937		1.039	1.109	1.14		1.052		0.418		0.838			0.289	0.773	0.902			1.100	1.186	0.9	0.451	0.804	0.825	0.827
1783	1.323		1.362	0.808	1.386		1.161	1.135	1.423		1.138	1.636	0.953		1.232			1.507	1.082	1.081			1.363	1.645	1.225	0.554	1.043	1.08	1.043
1784	1.286		1.391	0.975	1.356		1.370	1.198	1.403		1.121	1.614	1.149		1.274			1.886	1.176	1.169			1.293	1.631	1.174	0.597	1.248	1.374	1.307
1785	1.185		1.141	0.917	1.033		1.146	1.106	0.931		1.113	1.551	0.905		1.121			1.004	1.003	0.937			0.880	1.089	1.134	0.631	0.927	1.02	1.138
1786	1.018		1.271	0.840	0.845		0.956	1.117	0.955		0.998	1.332	0.462		0.902			0.357	1.073	0.703			0.947	0.964	0.805	0.358	0.955	1.098	0.775
1787	1.245		1.573	1.117	1.320		1.287	1.300	1.135		1.121	0.77	1.203		1.193			1.054	1.11	0.869			1.289	1.171	1.181	0.52	1.153	1.321	1.166
1788	0.901		1.297	0.956	0.652		1.037	1.037	1.177	0.965	1.128	0.323	0.835		1.251			0.698	1.334	0.872			1.047	0.821	1.474	0.477	1.228	1.304	1.138
1789	0.529		1.166	0.615	0.398		0.400	0.447	0.905	1.223	1.091	0.466	0.758		1.167			0.417	1.361	1.098			0.777	0.576	1.082	0.287	0.829	0.987	0.489
1790	1.073		1.798	1.149	1.082		1.413	1.403	1.074	1.151	1.157	0.614	1.066		1.305			1.218	1.266	0.968			1.284	1.303	1.321	0.503	1.464	1.504	1.101
1791	1.163		1.724	1.227	1.464		1.474	1.340	1.036	1.084	1.131	0.47	1.24		1.225			1.012	1.372	0.944			1.611	1.170	1.394	0.541	1.358	1.525	1.700
1792	1.198		1.413	1.275	1.311		1.267	1.221	0.892	1.254	1.308	0.504	1.144		1.269			1.128	1.321	0.945			1.036	1.049	1.249	0.508	1.261	1.527	1.336
1793	1.118		1.416	1.050	1.348		1.234	1.405	1.196	1.161	1.084	0.652	1.429		1.44			1.995	1.261	0.811			1.601	1.011	1.151	0.539	1.365	1.578	1.474
1794	1.048		1.167	0.688	1.227		1.044	0.808	0.941	0.756	0.923	0.964	1.29		1.231			0.865	1.214	0.943			1.308	0.743	0.91	0.602	1.037	1.165	1.062
1795	0.720		1.039	0.722	1.334		1.093	0.986	0.815	0.927	0.803	0.723	1.316		1.067			1.097	0.971	0.804			0.865	0.702	0.772	0.355	0.869	1.005	0.784
1796	0.779		0.967	0.880	1.405		1.277	1.314	0.807	1.313	0.875	0.788	1.097		1.003			0.814	1.091	0.985			1.148	0.883	1.006	0.591	1.074	1.144	1.142
1797	0.778		0.828	0.658	1.175		1.288	1.233	0.959	1.25	0.975	0.93	1.144		0.995			0.715	1.13	1.048			0.559	0.648	0.704	0.332	0.631	0.689	0.437
1798	0.726		0.811	0.869	1.107		1.246	1.113	0.775	1.408	0.934	1.023	0.857		0.947			0.99	1.114	1.095			0.715	0.671	0.639	0.313	0.727	0.82	0.577
1799	0.706		1.056	1.178	0.999		0.827	1.010	0.84	1.116	0.907	0.863	0.986		1.064			1.351	1.107	1.084			1.055	0.960	0.839	0.558	1.009	1.176	1.036
1800	0.909		0.983	0.962	1.422		1.235	1.097	0.901	0.403	0.948	0.847	1.067		1.101		1.257	1.232	1.091	1.021			1.543	1.091	0.956	0.537	1.224	1.356	1.506
1801	0.630		0.675	0.551	0.794		0.768	0.635	0.622	0.1	0.911	0.667	0.981		0.92		0.749	0.703	0.982	1.034			0.710	0.406	0.627	0.247	0.527	0.627	0.359
1802	0.813		0.982	0.838	0.949		0.938	0.972	0.848	0.228	0.835	0.793	1.017		1.059		0.773	0.966	0.947	1.099			0.848	0.865	0.739	0.606	1.208	1.2	0.885
1803	0.863		1.246	0.975	1.341		1.070	1.198	0.83	0.93	0.826	0.838	1.145		1.108		0.858	0.81	1.009	1.267			1.352	1.115	0.727	0.616	1.408	1.422	1.117
1804	0.818		0.938	1.021	1.267		1.132	1.156	0.887	1.384	0.971	0.964	1.411		1.154		1.068	1.135	1.084	1.451			0.897	0.958	0.905	0.595	1.305	1.326	1.164
1805	0.576		0.870	0.778	1.089		0.820	0.674	0.568	0.785	0.785	1.206	0.821		0.928		0.589	0.832	1.131	1.396			0.459	0.435	0.708	0.35	1.093	1.012	0.298
1806	0.278		0.619	0.258	0.849		0.326	0.260	0.363	0.337	0.506	0.773	0.703		0.674		0.417	0.367	0.648	0.802			0.395	0.241	0.537	0.201	0.723	0.639	0.363
1807	0.621		0.815	0.667	0.816		1.174	0.877	0.78	0.881	0.932	1.125	1.263		0.434		1.257	1.415	1.001	1.141			0.791	0.678	0.749	0.398	1.282	1.031	1.100
1808	0.540		0.918	0.714	0.879		1.048	0.906	0.755	1.09	1.084	1.405	1.649		0.684		1.325	1.201	1.13	1.488			0.778	0.830	0.785	0.478	0.96	0.905	0.750
1809	0.702		0.675	0.589	0.681		0.971	0.821	0.739	0.848	1.085	1.274	0.975		0.757		0.91	0.898	1.15	1.383			0.436	0.329	0.44	0.234	0.458	0.405	0.295

YEAR	POLDF	POLWF	FLEDF	FLEWF	LAJDF	LAJWF	ALADF	ALAWF	BARDF	BARWF	EFKDF	EFKWF	LEFDF	LEFWF	LOGDF	LOGWF	WVADF	WVAWF	PEHDF	PEHWF	FWNDF	FWNWF	REDDF	REDWF	BONDF	BONWF	SRRDF	SRRWF	RTCDF
1810	0.575		1.004	0.812	0.706		1.146	1.113	0.901	0.784	1.218	1.468	1.017		0.739		0.807	0.77	1.15	1.454			0.741	0.763	0.803	0.579	0.937	0.949	0.980
1811	0.788		0.979	0.847	0.892		1.199	1.170	1.135	1.324	1.171	1.177	1.036		0.806		1.161	0.951	1.157	1.418			0.602	0.619	0.604	0.537	0.612	0.708	1.034
1812	0.703		1.172	0.797	0.970		1.307	1.066	1.055	1.433	1.117	1.027	0.972		0.91		0.846	0.883	1.101	1.388			0.723	0.599	0.813	0.457	1.049	0.823	1.116
1813	0.573		1.050	0.777	0.875		1.253	1.035	1.053	1.141	1.027	1.072	0.626		0.867		0.702	0.574	0.935	1.275			0.893	0.684	0.812	0.696	1.041	0.969	1.184
1814	0.603		0.871	0.693	0.700		1.224	1.125	1.064	1.031	0.965	1.163	0.458		1.017		0.662	0.58	1.022	1.397			0.732	0.721	0.77	0.676	0.867	0.809	1.012
1815	0.638		0.958	0.790	0.863		1.094	1.094	1.466	1.726	1.048	0.981	0.875		1.18		1.387	1.291	0.838	1.266			0.911	0.883	0.903	0.862	1.101	1.157	1.283
1816	0.694		0.949	0.938	1.197		1.432	1.435	1.465	1.989	1.157	0.99	1.277		1.254		1.598	1.861	0.949	1.321			1.063	0.892	1.195	1.216	1.463	1.557	1.626
1817	0.501		0.740	0.926	1.311		1.173	1.103	1.112	1.394	0.854	1.09	0.928		1.05		1.088	1.094	0.88	1.244			0.787	0.703	0.936	0.947	1.004	1.082	1.206
1818	0.284		0.327	0.361	0.536	0.428	0.376	0.364	0.604	0.272	0.524	0.96	0.418		0.722		0.475	0.339	0.513	0.919			0.239	0.203	0.458	0.363	0.356	0.433	0.260
1819	0.402		0.442	0.548	0.670	0.616	0.819	0.883	1.09	1.007	0.613	1.263	0.578		0.721		0.777	0.602	0.469	1.004			0.329	0.245	0.489	0.498	0.318	0.402	0.513
1820	0.401		0.516	0.666	0.838	1.002	0.744	0.989	1.154	0.812	0.703	1.158	0.834		0.804		1.098	0.778	0.457	0.944			0.422	0.584	0.463	0.564	0.558	0.555	0.794
1821	0.644		0.667	0.752	0.920	1.090	0.953	1.065	1.512	1.163	0.813	1.063	1.086		0.896		1.391	1.25	0.582	1.079			0.419	0.578	0.836	0.738	0.96	0.92	1.633
1822	0.469		0.532	0.400	0.576	0.730	0.393	0.381	0.527	0.195	0.306	0.496	0.27		0.255		0.295	0.245	0.204	0.421			0.329	0.491	0.596	0.487	0.373	0.514	0.949
1823	0.584		0.781	0.781	0.738	0.926	0.762	0.978	1.31	0.587	0.687	0.982	0.644		0.522		0.832	0.624	0.519	0.854			0.456	0.964	0.689	0.777	0.912	1.087	1.050
1824	0.444		0.448	0.523	0.653	0.793	0.519	0.558	1.109	0.909	0.764	0.739	0.804	1.595	0.606		0.923	0.916	0.42	0.736			0.451	0.724	0.571	0.558	0.815	0.951	0.749
1825	0.708		0.676	0.775	0.839	1.156	0.840	0.917	1.092	0.977	0.919	0.932	0.856	1.223	0.683		1.019	1.103	0.561	0.857			0.563	0.974	0.681	0.893	1.052	1.272	1.101
1826	0.853		0.440	0.519	0.771	0.652	0.893	0.973	1.114	1.034	1.245	1.166	1.096	1.145	0.905		1.084	1.09	0.718	0.911			0.651	0.872	0.671	0.924	1.104	1.231	0.902
1827	1.012		0.734	0.859	0.891	0.891	1.097	1.079	1.223	0.802	0.996	0.926	1.074	0.837	0.797		0.831	0.745	0.65	0.681			0.871	0.832	0.825	0.947	1.085	1.168	1.265
1828	1.370		0.878	0.906	1.296	1.059	1.086	0.978	1.504	1.418	1.439	1.064	1.493	1.274	0.971		1.385	1.425	0.619	0.66			1.004	0.973	0.953	1.084	1.581	1.637	1.501
1829	1.020		0.835	0.738	0.903	0.813	1.026	1.080	1.061	0.782	0.941	1.113	0.752	0.66	0.833		0.734	0.774	0.619	0.556			0.753	0.802	0.922	0.903	0.993	0.954	1.118
1830	0.815		0.886	0.646	0.913	0.744	0.870	0.855	1.17	0.868	1.321	1.07	1.192	1.081	1.061		1.208	1.402	0.649	0.508			0.839	0.703	0.961	0.842	1.262	1.157	1.081
1831	1.011		0.856	0.624	1.148	1.120	1.204	1.156	1.539	1.071	1.229	1.05	1.128	1.099	0.969		1.193	1.085	0.624	0.496			1.142	1.038	1.173	0.937	1.262	1.101	1.827
1832	1.080		0.933	0.772	1.205	1.352	1.256	1.181	1.393	1.047	1.191	1.306	1.127	1.01	1.089		1.097	1.215	0.663	0.5			1.225	0.993	0.985	1.062	1.199	0.99	1.313
1833	0.982		0.854	0.838	1.136	1.348	1.237	1.128	1.235	1.619	1.314	1.229	1.046	0.763	1.126		1.413	1.383	0.723	0.518			1.208	0.942	1.017	0.984	1.08	0.944	1.529
1834	0.896		0.892	0.789	1.340	1.498	1.332	1.269	1.292	1.253	1.251	1.232	1.126	0.987	1.165		1.507	1.664	0.914	0.683			1.267	0.807	0.975	0.82	1.034	0.796	1.139
1835	0.998		1.096	0.854	2.012	1.495	1.456	1.319	1.679	1.238	1.235	1.377	1.01	0.864	1.148		1.115	1.193	0.963	0.691			1.473	0.930	1.147	1.13	1.311	1.063	1.672
1836	0.513		0.546	0.513	1.024	0.657	0.768	0.619	1.375	1.054	0.921	0.937	0.856	0.755	1.047		1.043	0.911	0.918	0.698			1.150	0.583	0.764	0.684	0.707	0.49	0.551
1837	0.779		0.778	0.761	1.393	1.271	1.300	1.105	1.242	0.983	1.356	1.126	1.198	1.235	1.245		1.255	1.139	1.106	0.858			1.737	0.814	1.12	0.936	1.463	1.134	1.397
1838	0.866		0.862	0.779	1.365	1.562	1.335	1.107	1.414	1.109	1.229	0.916	1.101	1.068	1.298		1.453	1.345	1.058	0.854			1.865	0.901	1.138	1.027	1.544	1.117	1.546
1839	0.994		0.886	0.845	1.462	1.799	1.155	1.071	1.437	1.662	1.355	0.948	1.364	1.515	1.137		1.634	1.555	1.116	0.935			1.715	0.847	1.047	0.904	1.561	1.027	1.485
1840	0.962	0.899	0.784	0.683	1.253	1.310	0.944	0.887	1.511	1.306	1.291	1.267	1.463	1.335	1.066		1.826	1.641	1.205	1.015			1.351	0.784	1.049	0.992	1.174	0.679	1.529
1841	0.868	0.625	0.786	0.626	0.980	1.294	0.964	0.874	1.582	1.271	1.183	0.822	1.553	1.331	1.211		1.386	1.349	1.155	1.017			0.983	0.673	0.927	0.724	0.996	0.784	0.927
1842	0.608	0.474	0.552	0.261	0.586	0.636	0.556	0.510	0.892	0.51	0.98	0.685	0.945	0.578	0.72		0.627	0.679	0.906	0.938			0.746	0.449	0.659	0.711	0.563	0.523	0.597
1843	1.238	0.448	1.123	0.690	1.571	1.379	1.140	1.117	1.001	0.599	1.071	0.742	0.992	1.099	0.942		0.995	0.854	1.126	1.091			1.742	0.853	1.29	1.102	0.978	0.74	1.639
1844	1.078	0.610	1.193	0.730	1.340	1.524	1.343	1.246	1.089	0.817	1.122	0.893	1.239	1.527	1.077		1.213	1.011	1.017	1.002			1.857	0.850	1.506	1.242	1.188	1.07	1.999
1845	0.854	0.749	0.768	0.616	0.941	1.009	0.889	0.864	0.786	0.382	0.929	0.723	0.802	0.557	1.029		0.615	0.491	0.895	0.911			1.113	0.798	1.076	1.036	0.962	0.685	1.097
1846	0.775	0.516	0.858	0.684	0.714	0.669	0.534	0.552	1.105	0.665	0.844	0.659	0.776	0.892	1.058		0.723	0.627	0.769	0.9			0.426	0.267	0.782	0.624	0.5	0.417	0.273
1847	0.622	0.637	0.536	0.433	0.801	0.679	0.486	0.520	0.356	0.257	0.396	0.282	0.396	0.229	0.588		0.225	0.196	0.528	0.769			0.510	0.375	0.539	0.47	0.569	0.485	0.451
1848	0.859	0.754	0.679	0.597	0.971	0.917	0.889	0.848	0.787	0.92	0.857	0.669	0.725	0.686	0.931		0.7	0.582	0.854	1.05			0.710	0.587	0.88	0.775	0.966	0.788	0.820
1849	0.751	0.523	0.756	0.622	0.984	1.116	0.767	0.811	0.935	1.424	0.958	0.82	1.008	1.225	1.079		1.053	1.094	1.025	1.147			0.876	0.786	0.904	0.882	1.099	1.006	0.663
1850	0.773	0.761	0.936	0.749	1.037	0.810	0.803	0.852	1.035	1.481	0.836	0.83	0.873	0.972	1.014		1.113	0.827	0.986	1.121			1.017	0.913	1.115	1.105	1.333	1.222	1.016
1851	0.271	0.048	0.362	0.206	0.381	0.496	0.292	0.285	0.638	0.689	0.456	0.468	0.463	0.352	0.688		0.327	0.36	0.676	0.838			0.385	0.441	0.412	0.289	0.361	0.246	0.060

YEAR	POLDF	POLWF	FLEDF	FLEWF	LAJDF	LAJWF	ALADF	ALAWF	BARDF	BARWF	EFKDF	EFKWF	LEFDF	LEFWF	LOGDF	LOGWF	WVADF	WVAWF	PEHDF	PEHWF	FWNDF	FWNWF	REDDF	REDWF	BONDF	BONWF	SRRDF	SRRWF	RTCDF
1852	0.814	0.831	1.060	0.714	0.971	0.792	0.854	0.924	1.183	1.354	0.952	0.736	1.232	1.16	1.219		0.963	1.092	1.07	1.258		0.963	0.648	0.750	1.093	0.956	0.907	0.94	1.226
1853	0.932	0.829	0.805	0.649	1.257	1.016	1.022	0.892	0.879	0.852	0.633	0.901	0.982	0.78	1.238		0.5	0.667	1.126	1.234		0.947	0.974	0.836	1.02	0.899	1.114	0.912	0.751
1854	0.945	0.992	1.251	0.769	1.271	1.100	1.267	1.218	0.938	0.768	0.828	1.25	0.797	1.023	1.247		0.701	1.022	1.129	1.342		1.117	1.140	1.183	1.177	1.082	0.931	1.053	1.115
1855	0.966	0.957	0.923	0.670	1.067	1.219	0.981	1.003	1.055	1.174	0.971	1.451	1.478	1.34	1.182		0.849	1.004	1.094	1.288		0.967	0.868	1.071	0.957	0.94	1.088	0.79	1.087
1856	0.927	1.105	1.205	0.625	0.913	1.063	0.956	1.092	1.106	1.124	1.096	1.376	1.402	1.245	1.235		0.913	1.164	1.102	1.067	0.986	0.988	0.714	1.147	1.254	1.133	1.215	0.969	1.055
1857	0.676	0.648	0.943	0.458	0.557	1.019	0.846	1.080	0.858	0.86	1.069	1.176	0.924	0.916	1.279		0.647	0.75	1.167	1.139	0.912	1.045	0.722	1.103	1.041	1.122	0.939	0.851	0.784
1858	0.866	1.212	1.146	0.707	1.206	1.330	0.997	1.297	1.079	0.726	1.24	1.113	1.195	1.144	1.331		1.052	1.26	1.141	1.041	0.832	0.951	0.953	1.049	1.116	1.483	1.346	1.265	1.247
1859	0.605	0.899	0.630	0.482	0.739	1.014	0.894	0.994	1.012	0.803	0.99	1.022	0.798	0.731	0.975		0.652	0.658	0.947	0.718	0.977	1.031	0.943	0.904	0.935	1.197	1.27	1.018	0.738
1860	0.673	0.951	0.853	0.508	0.793	0.884	0.971	0.959	0.833	0.787	0.956	1.011	0.854	0.785	0.981		0.524	0.541	1.105	0.866	1.069	1.000	1.040	0.915	1.397	1.345	1.192	0.857	0.946
1861	0.358	0.398	0.721	0.378	0.489	0.511	0.368	0.418	0.437	0.419	0.65	0.617	0.482	0.339	0.57		0.204	0.192	0.716	0.474	0.858	0.808	0.469	0.382	0.688	0.595	0.307	0.302	0.137
1862	0.772	0.936	0.719	0.414	0.868	0.686	1.034	1.049	0.734	0.657	0.871	0.777	0.743	0.749	0.97		0.632	0.5	0.923	0.652	0.872	0.965	0.866	0.880	1.261	1.129	1.226	0.931	1.162
1863	0.766	0.686	0.795	0.425	0.713	0.693	0.987	0.983	0.869	0.998	1.024	0.733	0.944	0.743	1.126		0.713	0.717	0.83	0.748	0.903	0.913	0.763	0.863	1.032	1.045	0.98	0.813	0.854
1864	0.969	1.021	0.814	0.519	1.012	0.890	1.139	1.212	0.784	0.804	0.762	0.662	0.72	0.639	0.851		0.495	0.616	0.742	0.544	1.082	1.129	0.763	0.961	1.062	1.24	0.715	0.749	1.424
1865	0.829	0.648	0.549	0.396	0.673	0.694	1.077	0.895	0.715	0.865	1.022	0.615	0.785	0.868	0.927	0.889	0.576	0.576	0.828	0.64	0.792	0.994	0.796	0.906	0.869	0.931	0.852	0.706	0.771
1866	1.177	0.999	0.899	0.547	0.830	0.965	1.486	1.246	0.958	1.324	1.51	0.871	1.264	1.351	1.447	1.061	1.09	1.043	1.218	0.967	1.127	1.239	1.330	1.303	1.457	1.404	1.185	1.032	1.255
1867	1.452	1.092	1.063	0.835	0.987	0.923	1.537	1.311	1.208	1.567	1.401	0.919	1.382	1.491	1.386	1.233	1.432	1.208	1.295	1.033	1.029	1.186	1.634	1.452	1.482	1.495	1.722	1.295	1.599
1868	1.387	1.290	1.211	0.905	1.121	1.074	1.263	1.251	1.205	1.506	1.415	1.286	1.335	1.267	1.358	1.067	1.505	1.435	1.289	1.197	1.110	1.173	1.384	1.469	1.398	1.608	1.525	1.274	1.028
1869	1.807	1.223	1.503	1.217	1.480	1.177	1.735	1.675	1.393	1.66	1.553	1.338	1.693	1.355	1.608	0.981	1.693	1.359	1.405	1.292	1.171	1.145	1.657	1.581	1.584	1.712	1.843	1.454	1.403
1870	1.430	0.764	1.125	0.899	1.013	1.037	1.102	1.247	1.095	0.962	1.17	1.147	1.19	0.73	1.079	0.772	1.079	1.003	1.136	1.097	1.018	1.005	1.223	1.231	1.009	1.363	0.656	0.7	0.426
1871	1.269	0.683	1.141	0.900	0.812	0.756	1.177	1.268	1.022	0.808	1.361	1.381	1.163	0.925	1.102	0.891	1.133	1.113	1.133	1.19	0.968	0.951	1.017	1.064	1.061	1.26	0.955	0.773	0.632
1872	1.324	0.645	1.293	0.960	1.013	0.837	0.918	1.259	1.177	1.189	1.099	1.278	1.089	1.003	1.005	0.906	1.497	1.233	0.916	1.129	1.007	0.952	1.159	1.312	1.147	1.544	1.306	1.213	0.934
1873	1.130	0.501	1.034	0.847	0.765	0.820	0.860	1.161	0.834	0.74	1.078	1.29	0.854	0.613	0.992	0.917	0.975	0.868	0.857	0.973	0.604	0.566	0.958	1.009	0.815	0.945	0.147	0.213	0.512
1874	1.023	0.695	0.903	0.681	0.931	0.834	0.901	0.969	0.92	0.878	1.037	0.99	1.065	0.72	0.955	0.81	0.827	0.78	0.847	0.871	0.715	0.821	0.930	0.989	0.94	1.107	0.976	0.843	0.642
1875	0.928	0.816	0.860	0.742	0.690	0.908	0.635	0.859	1.018	0.955	0.977	0.985	1.18	0.83	0.941	1.068	0.908	0.728	0.831	0.842	0.954	0.890	0.929	0.949	0.942	1.16	0.903	0.865	0.465
1876	1.415	1.008	1.105	0.974	1.212	1.109	1.079	1.211	0.984	0.701	1.149	1.02	1.115	0.852	0.906	0.97	0.512	0.499	1.049	0.999	1.060	0.894	1.290	1.081	1.145	1.424	1.057	1.03	0.499
1877	1.482	1.013	1.350	1.069	1.230	1.219	1.152	1.386	1.275	1.345	1.268	1.12	1.384	1.211	1.05	1.117	1.091	1.064	1.053	1.233	0.943	0.860	0.896	0.944	0.835	1.094	0.561	0.61	0.811
1878	1.577	0.914	1.468	1.172	1.003	1.066	1.177	1.293	0.862	0.939	1.139	1.213	1.104	0.918	1.04	1.164	0.848	0.877	1.156	1.202	0.949	0.862	1.006	1.114	1.138	1.41	1.114	1.152	1.074
1879	1.399	0.963	0.993	0.938	0.950	1.104	1.013	1.380	0.681	0.761	0.853	0.815	0.741	0.555	0.977	1.02	0.616	0.662	1.036	0.931	0.875	0.763	0.875	0.998	1.007	0.969	0.606	0.574	0.573
1880	0.397	0.184	0.615	0.582	0.292	0.583	0.362	0.501	0.39	0.316	0.459	0.512	0.467	0.427	0.754	0.863	0.406	0.403	0.622	0.577	0.808	0.667	0.696	0.901	0.928	0.798	0.409	0.46	0.136
1881	0.894	0.627	0.910	0.999	0.708	1.008	0.897	1.094	0.797	0.706	1.041	1.095	0.947	0.816	1.142	1.294	0.746	0.978	1.229	1.275	1.042	0.924	0.816	0.980	1.203	1.026	1.072	0.939	0.937
1882	1.449	0.990	1.102	1.179	1.202	1.191	1.098	1.243	0.892	0.955	1.105	0.99	1.105	1.193	1.01	1.061	0.913	1.402	1.143	1.142	1.090	1.056	1.116	1.172	1.389	1.331	1.232	1.294	1.227
1883	1.693	0.955	0.866	0.916	1.154	1.162	1.007	1.089	0.904	0.901	1.174	1.226	1.024	1.14	0.987	1.046	0.79	1.396	1.244	1.183	0.920	0.832	0.986	1.096	1.087	0.892	0.699	0.794	0.785
1884	1.704	1.086	0.939	1.105	1.363	1.388	1.459	1.744	0.989	1.26	1.134	1.335	1.065	1.154	1.074	1.057	0.944	1.353	1.266	1.368	1.079	0.990	1.042	1.325	1.242	1.322	1.324	1.419	1.139
1885	2.023	1.190	1.002	1.256	1.693	1.502	1.405	1.806	1.056	1.671	1.313	1.505	1.206	1.395	1.172	1.152	1.139	1.581	1.24	1.246	1.224	1.063	1.136	1.377	1.369	1.458	1.616	1.859	1.136
1886	1.784	1.137	1.064	1.236	1.530	1.295	1.123	1.519	1.01	1.245	1.088	1.117	1.261	1.048	1.138	0.921	1.196	1.176	1.046	0.906	1.064	0.933	0.952	1.197	1.209	1.199	1.426	1.296	0.822
1887	1.634	1.302	1.216	1.411	1.554	1.256	1.135	1.384	0.891	1.008	1.167	1.293	1.46	1.219	1.293	1.02	1.388	1.295	1.077	0.916	1.237	1.061	1.245	1.359	1.417	1.528	1.564	1.393	1.440
1888	1.390	1.378	1.174	1.518	1.400	1.262	1.044	1.258	1.007	1.235	1.136	1.18	1.315	1.128	1.283	1.029	1.301	1.186	0.998	0.728	1.254	1.108	1.109	1.276	1.335	1.335	1.443	1.212	1.177
1889	1.542	1.358	1.168	1.583	0.950	0.987	0.977	1.086	0.904	0.899	1.121	1.101	1.152	1.084	1.35	1.043	1.113	1.101	1.047	0.847	1.013	1.004	1.001	1.135	1.157	1.066	1.228	1.022	0.865
1890	1.021	1.020	0.932	1.412	0.851	0.870	0.809	0.913	0.74	0.573	0.797	0.73	0.74	0.723	1.134	0.985	0.679	0.653	0.921	0.728	0.890	0.907	0.880	0.928	0.797	0.883	0.702	0.669	0.669
1891	1.410	1.340	1.212	1.560	1.287	1.188	1.256	1.219	0.993	1.197	1.212	1.258	1.122	1.136	1.168	0.986	1.05	1.111	1.021	0.778	1.081	1.075	1.067	1.097	1.158	1.146	1.503	1.205	1.391
1892	1.418	1.136	0.844	1.244	1.098	0.914	1.075	1.003	0.826	1.095	1.055	1.073	0.984	0.979	1.049	0.926	1.01	0.997	0.975	0.762	1.063	1.110	0.997	1.148	1.117	1.118	1.168	1.098	1.091
1893	0.715	0.552	0.611	0.918	0.663	0.618	0.629	0.652	0.557	0.674	0.39	0.479	0.394	0.439	0.646	0.676	0.347	0.346	0.563	0.348	0.737	0.806	0.726	0.865	0.722	0.568	0.452	0.419	0.660

YEAR	POLDF	POLWF	FLEDF	FLEWF	LAJDF	LAJWF	ALADF	ALAWF	BARDF	BARWF	EFKDF	EFKWF	LEFDF	LEFWF	LOGDF	LOGWF	WVADF	WVAWF	PEHDF	PEHWF	FWNDF	FWNWF	REDDF	REDWF	BONDF	BONWF	SRRDF	SRRWF	RTCDF
1894	0.846	0.789	0.748	1.079	0.628	0.599	0.857	0.726	0.605	0.708	0.793	0.899	0.69	0.767	0.91	0.86	0.685	0.695	0.88	0.523	0.714	0.738	0.807	0.828	0.669	0.585	0.353	0.344	0.330
1895	1.429	1.268	1.194	1.200	1.051	1.098	0.874	0.639	1.045	1.329	0.899	0.842	1.02	1.029	1.046	1.043	1.388	1.178	1.089	0.723	1.203	1.095	1.373	1.185	1.231	1.171	1.253	1.142	1.736
1896	1.075	0.959	0.853	0.922	0.703	0.665	0.607	0.367	0.589	0.314	0.409	0.395	0.557	0.453	0.54	0.553	0.802	0.447	0.927	0.538	0.832	0.659	1.034	0.899	0.786	0.547	0.755	0.584	0.620
1897	1.456	1.375	1.148	1.237	1.167	1.003	1.124	0.706	1.292	1.491	1.044	1.016	1.006	0.997	1.013	1.008	1.352	1.22	1.13	0.715	1.045	0.938	1.195	1.263	0.925	0.643	1.078	0.866	1.489
1898	1.351	1.250	1.013	1.143	1.039	0.895	0.931	0.541	1.06	1.021	1.082	1.044	1.196	1.16	1.134	1.194	1.401	1.254	1.264	0.897	1.214	0.992	1.246	1.173	1.048	0.877	1.175	1.149	1.225
1899	0.891	0.910	0.696	0.737	0.607	0.730	0.619	0.459	0.525	0.604	0.534	0.428	0.66	0.599	0.756	0.906	0.514	0.386	0.785	0.622	0.936	0.683	0.933	0.901	0.761	0.529	0.369	0.356	0.444
1900	1.036	0.951	0.906	1.067	0.758	0.872	0.886	0.669	0.796	0.68	0.355	0.438	0.339	0.338	0.537	0.661	0.329	0.293	0.932	0.764	0.910	0.904	0.928	1.088	0.836	0.761	0.853	0.799	1.286
1901	1.164	1.206	1.047	1.224	0.763	0.976	0.980	0.847	0.701	0.649	0.601	0.75	0.714	0.803	0.708	0.998	0.707	0.613	1.037	0.992	0.740	0.820	0.746	0.954	0.677	0.637	0.646	0.753	0.718
1902	1.047	0.911	0.830	0.944	0.680	0.829	0.913	0.787	0.621	0.557	0.675	0.846	0.643	0.749	0.436	0.541	0.539	0.585	0.841	0.801	0.789	0.895	0.771	0.918	0.703	0.592	0.366	0.572	0.655
1903	1.405	1.206	1.228	1.516	0.984	1.244	1.075	1.032	0.809	1.085	0.792	1.28	0.69	1.324	0.798	1.184	0.725	1.035	1.101	1.266	1.069	1.275	1.155	1.366	1.061	1.286	1.367	1.446	1.217
1904	0.593	0.398	0.657	0.670	0.377	0.566	0.245	0.454	0.319	0.275	0.27	0.411	0.316	0.413	0.293	0.591	0.37	0.401	0.599	0.609	0.562	0.599	0.675	0.737	0.432	0.599	0.138	0.427	0.201
1905	1.408	1.023	0.996	1.069	0.925	1.029	0.881	0.754	1.014	1.151	1.03	1.276	1.039	1.3	0.947	1.133	1.049	1.162	1.142	1.331	0.981	1.071	1.038	1.149	0.99	1.01	1.315	1.268	1.044
1906	1.682	1.291	1.134	1.141	1.144	1.189	0.838	0.844	0.855	1.065	1.054	1.304	1.288	1.461	1.021	1.254	1.162	1.262	1.24	1.44	1.070	1.083	1.156	1.188	1.064	1.009	1.074	1.072	1.007
1907	1.999	1.298	1.570	1.442	1.596	1.345	1.410	1.276	1.224	1.364	1.498	1.689	1.854	1.712	1.462	1.474	1.824	1.745	1.675	1.724	1.254	1.195	1.243	1.277	1.308	1.349	1.298	1.219	1.747
1908	1.443	0.891	1.475	1.276	1.055	1.244	0.963	1.105	1.423	1.604	1.433	1.643	1.722	1.464	1.245	1.417	2.116	1.695	1.608	1.676	1.207	1.162	1.215	1.269	1.078	1.175	1.169	1.181	1.235
1909	1.681	1.326	1.311	1.402	1.302	1.342	1.286	1.367	1.043	1.049	1.374	1.495	1.275	1.309	1.161	1.293	1.38	1.346	1.355	1.507	1.165	1.059	1.170	1.221	1.068	1.078	0.93	0.813	0.927
1910	1.557	1.028	1.168	1.102	1.036	0.982	1.198	1.130	0.85	0.77	1.036	0.909	0.655	0.697	0.894	0.917	0.834	0.869	1.286	1.292	1.177	1.080	0.906	1.034	1.061	1.003	1.08	0.835	0.896
1911	1.654	1.336	1.526	1.481	1.325	1.193	1.340	1.413	1.144	1.157	1.2	1.303	1.284	1.261	1.16	1.29	1.367	1.255	1.505	1.523	1.147	1.188	1.031	1.232	1.195	1.178	1.074	1.086	1.206
1912	1.562	1.373	1.195	1.297	1.205	1.091	1.297	1.489	1.207	1.312	1.398	1.405	1.532	1.582	1.197	1.278	1.831	1.58	1.308	1.427	1.459	1.543	1.381	1.451	1.588	1.505	1.823	1.483	1.780
1913	1.316	1.301	1.068	1.259	1.018	1.108	1.389	1.492	1.029	1.121	1.049	1.202	0.874	1.011	1.031	1.161	1.206	1.212	1.306	1.475	0.973	1.100	0.894	1.036	1.022	0.94	0.838	0.818	0.668
1914	1.697	1.552	1.475	1.645	1.409	1.351	1.651	1.734	1.401	1.285	1.192	1.54	1.356	1.341	1.289	1.455	1.821	1.424	1.176	1.406	1.063	1.298	1.096	1.317	1.116	1.21	1.474	1.458	1.262
1915	1.517	1.223	1.108	1.246	1.101	1.032	1.417	1.368	1.159	1.177	1.294	1.561	1.435	1.392	1.134	1.396	1.806	1.486	0.933	1.225	1.118	1.259	1.051	1.185	1.123	1.11	1.75	1.459	1.241
1916	1.455	1.273	0.916	1.050	1.006	1.068	1.348	1.241	1.048	1.253	1.449	1.679	1.397	1.56	1.022	1.306	1.88	1.723	0.852	0.939	1.057	1.131	0.997	1.087	0.925	1.046	1.27	1.093	0.852
1917	1.286	1.145	0.804	0.926	0.915	0.934	1.250	1.172	0.991	1.104	1.174	1.528	1.338	1.497	0.845	0.874	1.575	1.279	0.695	0.439	1.332	1.371	1.320	1.359	1.083	1.203	1.293	1.181	1.289
1918	1.260	1.345	1.061	1.247	1.042	1.125	1.040	1.185	0.813	0.996	0.992	1.139	0.821	0.977	0.737	0.822	1.218	1.159	0.739	0.582	0.997	1.062	1.139	1.279	0.889	1.063	0.497	0.686	1.095
1919	1.375	1.443	1.380	1.463	1.227	1.314	1.381	1.431	1.194	1.581	1.038	1.272	1.225	1.373	0.845	0.897	1.863	1.546	0.92	0.571	1.506	1.528	1.541	1.559	1.192	1.347	1.41	1.362	1.460
1920	1.242	1.201	1.124	1.282	1.075	1.126	1.240	1.392	1.228	1.324	0.961	1.024	1.33	1.302	0.733	0.608	2.06	1.638	0.856	0.389	1.335	1.357	1.229	1.429	0.904	1.114	1.575	1.592	1.157
1921	1.349	1.359	1.357	1.548	1.718	1.399	1.388	1.592	1.255	1.421	1.011	1.212	1.318	1.402	0.942	0.906	1.704	1.617	0.999	0.666	1.582	1.577	1.633	1.754	1.161	1.339	1.85	1.797	1.516
1922	0.728	0.747	0.813	1.144	0.748	0.757	0.667	0.725	0.846	0.847	0.636	0.931	0.65	0.72	0.839	0.801	0.917	0.854	1.008	0.734	1.024	0.988	0.828	0.986	0.949	1.035	0.728	0.697	0.771
1923	0.734	0.985	0.626	1.093	0.805	1.121	0.895	1.037	0.849	1.031	0.476	0.754	0.371	0.528	0.702	0.74	0.603	0.735	0.827	0.722	0.721	0.820	0.643	0.778	0.656	0.792	0.528	0.604	0.631
1924	0.872	1.030	0.847	1.406	0.833	0.969	1.067	1.190	1.024	1.156	0.842	1.017	1.013	1.07	1.034	1.205	1.344	1.344	1.093	0.983	0.929	1.041	0.875	1.052	0.796	1.003	1.458	1.315	0.796
1925	0.579	0.800	0.753	1.223	0.648	0.959	0.390	0.615	0.89	0.977	0.597	0.635	0.475	0.545	0.76	0.937	0.519	0.588	0.796	0.81	0.808	0.812	0.763	0.735	0.767	0.803	0.983	0.899	0.517
1926	1.100	1.214	1.038	1.594	1.276	1.291	1.115	1.204	1.326	1.306	1	0.949	1.164	1.169	1.196	1.34	1.445	1.341	1.22	1.254	1.143	1.157	1.130	1.136	0.888	1.063	1.238	1.372	1.212
1927	0.972	1.035	1.072	1.621	1.199	1.065	0.812	1.002	0.876	0.931	1.043	0.82	0.907	0.942	1.073	0.957	0.958	1.073	1.388	1.166	1.009	0.958	1.018	0.990	0.883	0.921	1.127	1.288	0.910
1928	0.729	0.754	0.998	1.441	0.937	0.821	0.965	1.031	0.793	0.778	0.786	0.718	0.587	0.636	0.742	0.806	0.795	0.816	1.196	1.034	0.982	0.910	0.828	0.808	0.882	0.789	0.958	0.913	0.897
1929	1.103	1.096	1.291	1.672	1.239	1.240	1.098	1.359	0.879	0.876	1.021	0.977	0.814	0.886	0.967	1.07	0.878	1.076	1.316	1.189	1.001	1.007	0.922	0.913	0.886	0.95	0.936	0.992	0.764
1930	1.110	0.983	1.090	1.397	1.160	1.043	0.991	1.178	0.891	0.892	0.872	0.968	0.965	1.025	1.045	1.215	1.136	1.386	1.211	1.12	1.012	0.994	1.022	0.950	1.093	1.025	0.846	0.886	1.011
1931	1.121	0.898	0.903	1.185	1.101	1.097	1.123	1.253	0.759	0.789	0.927	0.923	0.622	0.618	0.926	0.991	0.93	1.007	1.182	1.049	1.005	0.867	1.016	0.823	1.126	0.858	0.747	0.669	0.851
1932	1.259	1.039	1.172	1.511	1.375	1.196	1.012	1.350	0.992	0.992	1.26	1.217	1.484	1.216	1.283	1.324	1.718	1.729	1.328	1.268	1.111	0.998	1.197	0.991	1.093	0.984	1.492	1.228	1.082
1933	1.199	0.972	1.101	1.273	1.508	1.143	1.045	1.223	1.181	1.07	1.237	1.187	1.073	0.857	1.214	1.257	1.66	1.429	1.473	1.344	1.067	0.876	1.207	0.928	1.352	1.044	0.64	0.632	1.319
1934	0.502	0.526	0.545	0.678	0.840	0.707	0.325	0.441	1.025	0.893	1.057	0.937	0.684	0.642	0.892	0.987	1.102	1.03	1.333	1.341	0.886	0.812	0.687	0.522	1.021	0.759	0.998	0.838	0.716
1935	1.038	0.905	1.029	1.131	1.102	1.019	0.827	0.999	1.149	1.047	1.144	1.034	1.161	0.922	1.033	1.194	1.458	1.456	1.248	1.403	1.063	1.108	0.949	0.894	1.315	1.062	1.176	1.076	1.233

YEAR	POLDF	POLWF	FLEDF	FLEWF	LAJDF	LAJWF	ALADF	ALAWF	BARDF	BARWF	EFKDF	EFKWF	LEFDF	LEFWF	LOGDF	LOGWF	WVADF	WVAWF	PEHDF	PEHWF	FWNDF	FWNWF	REDDF	REDWF	BONDF	BONWF	SRRDF	SRRWF	RTCDF
1936	1.031	0.863	0.896	1.064	1.066	0.905	1.020	1.145	1.353	1.279	1.207	1.192	1.041	0.981	1.071	1.268	1.356	1.317	1.196	1.345	0.961	1.009	0.844	0.702	1.169	0.919	0.93	0.838	1.024
1937	1.171	0.973	0.977	1.247	1.128	1.121	1.074	1.193	1.436	1.267	1.38	1.213	1.255	1.255	1.088	1.116	1.374	1.415	1.099	1.313	1.166	1.360	1.087	0.992	1.688	1.317	1.413	1.455	1.463
1938	1.041	1.006	0.750	1.094	0.974	0.996	0.833	0.783	1.073	1.067	1.343	1.238	0.978	1.04	1.064	1.078	0.938	0.948	1.234	1.342	1.108	1.293	1.069	0.981	1.483	1.283	1.264	1.188	1.234
1939	0.963	1.080	0.483	0.762	0.753	0.885	0.620	0.620	0.877	0.815	1.193	1.286	0.998	1.132	0.99	1.043	0.992	1.155	1.281	1.587	0.790	0.847	0.735	0.661	1.038	1.242	0.947	0.921	0.518
1940	1.007	1.168	0.654	0.940	0.897	1.040	0.723	0.570	1.144	1.016	1.023	1.332	0.779	0.979	1.063	1.022	1.07	1.108	1.156	1.509	0.619	0.754	0.760	0.657	1.037	1.514	0.573	0.651	1.199
1941	1.155	1.429	0.927	1.215	1.118	1.195	0.855	0.545	1.26	1.214	1.28	1.579	1.53	1.789	1.074	0.877	1.755	1.707	1.342	1.599	1.017	1.388	1.334	1.237	1.383	1.883	1.467	1.539	1.629
1942	0.912	1.027	0.633	0.858	0.965	0.970	0.960	0.549	0.967	0.971	1.218	1.435	1.302	1.706	0.936	0.637	1.465	1.524	1.24	1.371	0.936	1.122	1.139	1.100	1.363	1.61	1.389	1.33	1.242
1943	0.661	0.836	0.557	0.941	0.675	0.963	0.765	0.723	0.762	0.754	0.998	1.142	0.816	1.029	0.892	0.687	1.034	1.076	1.293	1.258	0.556	0.605	0.598	0.557	1.078	1.465	0.382	0.613	0.459
1944	0.970	1.070	0.769	1.255	1.025	1.176	1.207	1.075	0.862	0.774	1.191	1.065	0.96	0.851	1.105	0.753	1.293	1.088	1.281	1.093	1.137	1.330	1.150	1.177	1.483	1.636	1.675	1.434	1.390
1945	0.804	0.984	0.640	1.007	1.131	1.115	1.024	0.861	0.751	0.64	1.034	0.822	0.743	0.698	1.008	0.624	1.059	0.928	0.965	0.878	0.877	1.142	0.923	1.003	1.181	1.409	1.333	1.233	0.906
1946	0.509	0.534	0.454	0.727	0.803	0.824	0.713	0.468	0.696	0.518	0.39	0.332	0.128	0.175	0.491	0.452	0.395	0.355	0.511	0.507	0.471	0.500	0.495	0.402	0.742	0.916	0.223	0.371	0.276
1947	0.675	0.605	0.799	0.912	0.912	0.913	1.003	0.669	1.171	0.832	1.057	0.843	0.852	0.755	0.856	0.663	0.93	0.839	0.895	0.758	1.159	1.340	1.118	0.982	1.359	1.175	1.387	1.173	1.587
1948	0.951	0.938	0.951	0.972	1.347	1.261	1.134	0.678	1.108	1.04	0.922	0.756	0.908	0.801	1.074	0.886	1.296	1.112	0.889	0.64	0.875	1.082	0.939	0.875	1.278	1.156	1.035	1.002	1.318
1949	0.935	1.008	1.129	1.167	1.215	1.256	1.091	0.660	1.236	1.241	1.117	0.839	1.067	1.007	1.181	0.977	1.247	1.115	0.994	0.592	1.122	1.353	1.134	0.983	1.714	1.366	1.442	1.362	1.301
1950	0.493	0.587	0.734	0.720	0.690	0.775	0.363	0.297	0.576	0.562	0.46	0.351	0.252	0.289	0.788	0.717	0.446	0.378	0.932	0.458	0.599	0.832	0.687	0.577	1.429	1.06	0.564	0.904	0.770
1951	0.326	0.397	0.528	0.442	0.447	0.502	0.323	0.235	0.604	0.515	0.215	0.214	0.144	0.182	0.43	0.473	0.287	0.232	0.459	0.258	0.493	0.569	0.523	0.457	0.911	0.663	0.833	0.71	0.717
1952	0.724	0.683	0.747	0.750	0.741	0.751	0.784	0.438	1.027	0.906	0.818	0.507	0.872	0.77	0.901	0.862	1.037	0.982	0.788	0.483	0.580	0.688	0.554	0.538	0.851	0.761	0.739	0.666	0.650
1953	0.702	0.835	0.916	0.955	0.768	0.733	0.921	0.756	0.798	0.814	0.517	0.401	0.431	0.464	0.625	0.681	0.525	0.572	0.745	0.529	0.739	0.910	0.656	0.738	1.129	0.867	0.966	0.976	0.994
1954	0.429	0.572	0.993	1.066	0.470	0.540	0.538	0.635	0.804	0.826	0.541	0.401	0.734	0.789	0.729	0.783	0.756	0.794	0.738	0.502	0.627	0.946	0.597	0.782	1.049	1.197	0.723	1.02	0.768
1955	0.922	0.938	1.166	1.080	0.919	0.946	1.044	0.932	0.668	0.542	0.357	0.234	0.256	0.336	0.424	0.38	0.299	0.295	0.642	0.357	0.937	1.187	0.909	0.978	1.462	1.297	0.953	1.244	1.130
1956	0.427	0.496	0.738	0.708	0.379	0.392	0.402	0.452	0.704	0.558	0.454	0.303	0.275	0.332	0.361	0.366	0.343	0.309	0.469	0.341	0.324	0.434	0.439	0.415	1.017	0.978	0.062	0.221	0.294
1957	0.728	0.844	0.816	0.657	0.697	0.797	0.800	0.656	0.771	0.789	0.442	0.352	0.547	0.531	0.577	0.606	0.53	0.541	0.511	0.403	0.845	1.203	0.836	1.064	1.166	1.264	1.22	1.447	1.246
1958	0.936	0.929	0.814	0.819	0.762	0.819	1.042	0.691	0.886	0.948	0.781	0.662	0.886	0.995	0.901	0.935	0.893	0.946	0.81	0.658	1.053	1.303	1.059	1.277	1.435	1.35	1.437	1.495	1.220
1959	0.748	0.801	0.854	0.673	0.717	0.813	1.068	0.583	0.835	1.054	0.995	0.783	1.016	1.187	0.971	0.957	0.733	0.77	1.04	0.723	0.736	0.949	0.700	0.853	1.344	1.386	0.9	1.28	0.964
1960	0.965	0.902	0.754	0.610	0.775	0.794	1.267	0.667	0.917	1.162	1.147	0.96	1.303	1.408	1.162	1.168	0.82	0.734	1.13	0.757	0.985	1.250	0.965	1.099	1.805	1.57	1.235	1.646	1.071
1961	1.078	0.872	0.712	0.453	0.835	0.855	1.123	0.441	0.799	1.157	1.28	1.155	1.356	1.394	1.223	1.06	0.793	0.889	1.128	0.642	0.932	1.162	1.054	1.296	1.464	1.338	0.742	1.114	0.867
1962	0.999	0.768	0.751	0.472	0.784	0.788	1.083	0.366	0.938	1.082	1.183	1.157	0.991	1.122	1.104	1.075	0.839	0.877	1.041	0.694	0.726	0.921	0.981	1.306	1.064	0.978	0.532	0.787	0.489
1963	0.537	0.524	0.738	0.362	0.524	0.526	0.775	0.380	0.628	0.792	0.884	0.946	0.557	0.66	0.839	0.687	0.433	0.485	0.913	0.681	0.462	0.543	0.501	0.530	0.939	0.942	0.425	0.644	0.290
1964	0.487	0.536	0.984	0.609	0.534	0.517	0.750	0.503	1.034	0.952	0.725	0.911	0.732	0.596	0.706	0.66	0.72	0.555	0.844	0.704	0.579	0.604	0.671	0.688	0.978	0.923	0.222	0.398	0.783
1965	1.003	0.970	1.481	0.834	1.051	0.986	1.274	0.762	1.436	1.598	1.162	1.203	1.36	1.183	1.198	1.307	1.523	1.296	1.172	1.069	1.315	1.344	1.324	1.379	1.833	1.257	1.523	1.552	1.584
1966	0.819	0.905	1.607	1.005	0.867	0.845	1.356	0.920	1.162	1.456	1.394	1.258	1.248	1.111	1.417	1.398	1.089	1.029	1.207	1.285	1.194	1.289	1.214	1.165	2.259	1.493	0.639	1.099	1.228
1967	0.444	0.653	1.300	0.731	0.574	0.643	0.415	0.540	0.655	0.81	0.825	0.89	0.337	0.273	0.559	0.691	0.288	0.275	0.769	1.131	0.800	0.884	1.063	1.238	1.488	0.946	0.11	0.51	0.510
1968	0.987	1.079	1.413	1.045	1.031	0.962	1.250	1.084	1.527	1.583	1.232	1.073	1.182	1.028	1.264	1.374	0.963	1.052	1.174	1.461	1.065	1.012	1.326	1.479	1.535	1.066	1.139	1.096	1.187
1969	1.134	1.453	1.757	1.247	1.303	1.329	1.348	1.378	1.432	1.556	1.31	1.128	1.33	1.219	1.25	1.454	1.151	1.206	1.127	1.468	1.145	1.124	1.337	1.319	1.353	0.922	0.955	1.014	1.565
1970	1.195	1.466	1.826	1.267	1.243	1.262	1.321	1.498	1.656	1.789	1.4	1.304	1.746	1.605	1.356	1.537	1.199	1.237	1.194	1.493	1.131	1.131	1.216	1.258	1.232	0.88	0.823	1.028	1.245
1971	0.589	0.817	1.280	0.847	0.679	0.695	0.602	0.942	0.596	0.639	1.038	1.06	0.437	0.479	0.704	0.837	0.181	0.219	0.779	1.279	0.499	0.426	0.519	0.526	0.705	0.546	0.124	0.38	0.145
1972	1.049	1.206	1.738	1.100	0.994	0.855	1.573	1.503	1.052	1.145	1.144	1.109	1.406	1.268	1.1	1.306	0.886	1.08	0.912	1.536	1.435	1.060	1.239	1.129	1.464	1.067	1.446	1.738	1.157
1973	0.968	1.137	1.364	1.160	1.002	1.020	1.193	1.405	1.464	1.64	1.086	1.137	1.55	1.233	1.178	1.406	1.157	1.267	0.978	1.379	1.328	0.856	1.194	1.309	1.078	0.849	1.23	1.54	1.316
1974	0.668	0.957	1.186	1.013	0.739	0.749	0.818	1.072	0.935	0.987	0.969	1.018	0.764	0.635	1.065	1.092	0.494	0.604	0.973	1.208	1.017	0.765	0.946	1.029	1.088	0.797	0.556	0.801	0.908
1975	1.022	1.314	1.752	1.456	1.178	1.182	1.314	1.491	1.365	1.552	1.186	1.221	1.417	1.353	1.308	1.409	0.976	1.318	0.966	1.484	1.153	0.892	1.356	1.478	1.23	0.886	1.149	1.479	0.761
1976	0.790	1.150	1.198	1.101	0.985	0.971	0.966	1.229	0.827	0.804	0.984	1.062	0.7	0.759	1.224	1.34	0.47	0.626	0.799	1.56	1.116	1.005	1.040	1.372	0.959	0.818	0.82	1.102	0.590
1977	0.622	0.898	0.916	0.890	0.691	0.807	0.958	1.103	0.814	0.691	0.911	1.012	0.459	0.469	0.94	1.018	0.309	0.379	0.692	1.333	0.959	0.630	0.699	0.865	1.05	0.763	0.451	0.973	0.561

YEAR	POLDF	POLWF	FLEDF	FLEWF	LAJDF	LAJWF	ALADF	ALAWF	BARDF	BARWF	EFKDF	EFKWF	LEFDF	LEFWF	LOGDF	LOGWF	WVADF	WVAWF	PEHDF	PEHWF	FWNDF	FWNWF	REDDF	REDWF	BONDF	BONWF	SRRDF	SRRWF	RTCDF
1978	0.943	1.098	1.154	1.199	1.056	1.074	0.953	1.229	1.318	1.32	1.228	1.214	1.38	1.242	1.253	1.442	1.007	1.265	0.772	1.608	0.984	0.601	0.991	1.035	1.176	0.854	1.201	1.326	1.054
1979	1.086	1.253	1.204	1.142	1.248	1.218	1.143	1.389	1.524	1.585	1.429	1.429	1.63	1.515	1.55	1.762	1.247	1.489	0.906	1.775	1.264	0.925	1.218	1.317	1.35	1.05	1.18	1.677	1.221
1980	1.013	1.273	0.904	0.990	1.104	1.067	1.027	1.340	1.342	1.171	1.205	1.363	1.452	1.613	1.309	1.6	0.995	1.258	0.815	1.73	0.991	0.694	0.980	1.076	0.995	0.777	1.057	1.427	0.941
1981	0.670	1.113	0.863	0.863	0.826	0.963	0.685	1.144	0.992	0.839	0.922	1.13	1.075	1.432	1.366	1.538	0.51	0.695	0.789	1.502	0.618	0.315	0.724	0.603	0.798	0.631	0.435	0.724	0.789
1982	0.970	1.528	1.183	1.322	1.368	1.386	0.972	1.423	1.09	0.696	1.082	1.149	1.296	1.471	1.353	1.587	0.819	0.954	0.713	1.199	0.886	0.577	0.685	0.588	0.781	0.697	0.416	0.791	0.809
1983	1.161	1.705	1.231	1.341	1.707	1.708	1.065	1.397	1.236	0.66	1.347	1.299	1.802	1.783	1.221	1.454	1.44	1.611	0.663	0.966	1.275	0.318	1.074	0.545	0.777	0.497	1.271	1.547	1.692
1984	1.192	1.594	1.052	1.289	1.268	1.431	1.018	1.283	1.582	0.447	1.169	0.969	1.103	1.17	1.191	0.923	0.897	0.928	0.69	0.816	2.069	0.645	1.488	0.942	0.789	0.441	1.168	1.302	1.190
1985	1.421	1.871	1.330	1.505	1.780	1.684	1.433	1.548	1.559	0.359	1.236	0.877	1.527	1.165	1.424	1.058	1.601	1.591	0.765	0.514	1.887	0.427	1.603	0.783	0.733	0.457	1.124	1.265	1.560
1986	1.656	2.142	1.420	1.338	1.983	1.922	1.690	1.662	2.514	0.762	1.502	0.942	1.817	1.402	1.726	1.489	1.371	1.256	0.907	0.683	3.270	0.592	2.081	0.507	1.047	0.357	1.061	1.368	1.331
1987											1.374	1.159	1.636	1.547					0.436		5.054	1.361	2.333	1.404					1.432
1988																1.089													1.089
1989																0.995													0.995

APPENDIX B

Douglas-Fir and White Fir

Corrected Tree-Ring Chronology Listings

These are corrected mean ring-width chronologies (i.e., effects of climate have been fileterd out) from all mixed conifer sites sampled during this project. These chronologies are included in magnetic form in a Quattro Pro spreadsheet file called "ALLNEWC1.WQ1".

YEAR	POLDF	POLWF	FLEDF	FLEWF	LAJDF	LAJWF	ALADF	ALAWF	BARDF	BARWF	EFKDF	EFKWF	LEFDF	LEFWF	LOGDF	LOGWF	WVADF	WVAWF	PEHDF	PEHWF	FWNDF	FWNWF	REDDF	REDWF	BONDF	BONWF	SRRDF	SRRWF	RTCDF
1600																									1.129				1.262
1601																									1.277				1.043
1602							1.265																		0.864				1.103
1603							1.504																		0.941				1.087
1604							1.495																		0.855				1.077
1605							0.988																		0.794				0.654
1606							0.984																		0.867				0.431
1607							0.880																		0.887				0.513
1608							1.201																		0.903				0.916
1609							0.904																		1.201				1.067
1610							0.167																		0.626				0.518
1611							0.335																		0.711				0.625
1612							0.141																		0.415				0.215
1613							0.351																		0.553				0.769
1614							0.773																		0.453				0.505
1615							0.904																		0.704				0.766
1616							1.169																		0.986				1.138
1617							0.449																		0.662				0.653
1618							0.345																		0.454				0.692
1619							0.882																		0.815				0.853
1620							1.291												0.882						1.049				0.775
1621							1.353												0.638						0.852				0.672
1622							1.547												1.128						0.982				0.597
1623							1.404												1.386						1.248				1.296
1624							1.586												1.535						1.355				1.050
1625							1.370												1.611						1.044				0.930
1626							1.372												1.346						1.169				1.049
1627							1.191												1.217						1.095				1.423
1628							1.553												1.619						1.149				1.269
1629							0.531												1.377						0.980				1.200
1630							0.922	1.731											0.890						1.053				1.053
1631							1.559	0.384											1.258						1.307				0.974
1632							1.173	1.241											1.329						1.359				0.989
1633							0.949	1.396											0.921						1.173				1.251
1634							0.735	1.271											1.044						1.111				1.393
1635							1.413	1.284											0.943						0.811				1.132
1636							1.318	1.028											0.996						0.832				1.155
1637							1.162	1.171											1.103						0.875				1.063

YEAR	POLDF	POLWF	FLEDF	FLEWF	LAJDF	LAJWF	ALADF	ALAWF	BARDF	BARWF	EFKDF	EFKWF	LEFDF	LEFWF	LOGDF	LOGWF	WVADF	WVAWF	PEHDF	PEHWF	FWNDF	FWNWF	REDDF	REDWF	BONDF	BONWF	SRRDF	SRRWF	RTCDF
1638							1.868	1.584											1.177						1.232				0.984
1639							1.186	0.845											0.831						0.607				1.135
1640							1.162	0.706											0.891						0.537				0.672
1641							1.497	1.131											1.005						1.123				0.770
1642							0.728	0.529											1.095						0.708				0.729
1643							0.742	0.567											0.999						0.663				0.546
1644							0.791	0.497											0.717						0.874				0.845
1645							0.559	0.410											1.281						1.375				0.998
1646							1.051	0.626											0.862						0.653				0.765
1647							1.368	1.057											0.820						0.968				0.894
1648							1.444	1.493											1.280						1.386				1.170
1649							1.138	1.021											1.049						1.137				1.339
1650							1.546	1.211											0.989						1.065				1.171
1651							1.244	0.967											0.401						0.887				0.710
1652							1.195	1.276											0.239						0.881				1.141
1653							1.772	2.186											0.660						1.232				1.234
1654							1.355	1.572											0.959						1.347				0.916
1655							1.022	1.097											0.785						0.486				0.996
1656	0.059						0.744	0.568											0.792						0.825				1.167
1657	1.122						1.218	1.316											0.697						0.671				1.260
1658	1.241						1.079	0.889											0.931						1.230				1.375
1659	0.769						0.905	0.881											1.294						0.759				1.081
1660	0.759						0.861	0.844											0.625						0.880				1.281
1661	0.602						0.975	1.115											0.440						0.817				0.994
1662	0.270						0.897	0.783											0.049						1.081				0.958
1663	0.570						1.103	0.953											0.229						1.144				1.080
1664	0.905						1.174	1.262											0.931						1.068				1.116
1665	0.908						0.971	1.167											0.396						0.934				0.976
1666	0.853						1.031	1.041											0.663						1.284				0.926
1667	1.303						1.360	1.389											0.917						1.006				1.134
1668	0.944						1.025	1.108											0.801						1.161				0.966
1669	0.739						0.813	0.967											0.781						1.083				1.094
1670	0.803						1.052	1.175											0.704						0.901				0.934
1671	1.054						1.233	1.540											0.727						1.361				1.097
1672	1.023						0.975	1.257											0.804						1.468				1.186
1673	0.914						0.928	1.165											0.636						1.199				1.114
1674	1.245						1.037	1.348											0.377						0.945				1.048
1675	1.318						1.278	1.456											0.613						1.445				1.135

YEAR	POLDF	POLWF	FLEDF	FLEWF	LAJDF	LAJWF	ALADF	ALAWF	BARDF	BARWF	EFKDF	EFKWF	LEFDF	LEFWF	LOGDF	LOGWF	WVADF	WVAWF	PEHDF	PEHWF	FWNDF	FWNWF	REDDF	REDWF	BONDF	BONWF	SRRDF	SRRWF	RTCDF
1676	1.714						1.468	1.868											1.042						1.053				0.832
1677	1.289						1.357	1.624											0.962						0.946				1.176
1678	1.618						1.286	1.609											0.784						0.855				1.495
1679	1.290						1.217	1.287											0.704						1.299				1.289
1680	1.381						1.060	1.438					0.494						0.494						0.430				1.022
1681	1.287						0.924	1.001					0.925						0.707						1.159	1.267			1.234
1682	1.769						1.199	1.795					0.759						0.438						0.769	0.874			0.815
1683	1.508						1.007	1.477					0.724						0.409						0.952	1.155			1.230
1684	1.172						0.825	1.269					0.878						0.768						1.163	1.206			1.067
1685	1.366				1.893		1.113	1.661					0.999						1.194						0.905	1.315			1.042
1686	1.473				1.190		1.361	1.747					0.839						1.106						0.981	0.964			0.870
1687	1.654				0.618		1.182	1.781					0.949						1.039						0.900	1.047			1.033
1688	1.181				0.367		1.047	1.448					0.913						0.658						1.150	0.944			1.130
1689	1.617				0.502		1.079	1.534					0.613						0.449						0.927	0.747			1.140
1690	1.550			0.840	1.035		1.284	1.374					1.107						1.004						1.407	1.152			1.407
1691	1.530			1.234	0.909		1.189	1.185					1.045						1.467						1.259	1.221			1.146
1692	1.953			0.645	0.843		1.122	1.123					0.585						1.085						1.143	1.106			1.403
1693	1.588			0.495	0.802		0.992	0.860					1.058						1.637						1.008	0.590			1.427
1694	1.085			0.585	0.933		0.858	0.712					0.748						1.844						1.350	1.231			1.114
1695	1.545			1.004	1.352		1.155	1.012					0.638						1.638						0.810	0.712			0.981
1696	1.353			1.635	1.213		1.201	1.143					1.063						2.318						1.222	1.231			1.165
1697	1.757			1.375	1.018		1.220	0.893					0.650						1.610						0.538	0.755			1.182
1698	1.872			1.409	1.514		1.340	1.090					1.026						2.064						1.087	1.076			1.256
1699	1.282			1.429	0.874		1.101	0.806					0.222						1.194						0.893	1.162			1.140
1700	1.403			1.523	0.815		1.173	1.054					0.827						1.983						1.061	1.288			0.948
1701	1.238			1.601	0.768		1.069	0.815					0.736						1.164						0.616	0.727			1.069
1702	1.140			1.579	0.782		1.163	0.894					1.348						2.180						0.888	1.005			0.732
1703	1.470			1.298	0.758		1.339	1.086					1.225						2.855						0.790	0.460			0.969
1704	1.046			1.269	0.794		1.105	0.996					1.303						2.895						1.402	1.354			1.054
1705	1.050			1.150	0.761		1.133	1.107					1.186						2.427						1.345	2.047			1.037
1706	1.602			0.906	1.155		1.408	1.409					0.977						1.564						0.592	1.183			0.948
1707	1.482			1.548	1.260		1.202	1.114					1.448						1.961						1.517	1.716			1.176
1708	1.515			1.493	1.130		1.211	1.348					1.130						1.600						0.815	1.053			0.738
1709	1.099			1.505	0.890		1.103	1.306					1.024						1.215						1.338	1.554			0.954
1710	1.676			1.228	1.073		1.049	1.150					0.700						●						0.579	1.061			0.860
1711	1.287			1.455	1.667		1.013	0.830					1.226						1.612						0.905	1.291			0.934
1712	1.058			1.718	1.398		1.089	0.853					0.891						0.826						0.434	0.918			0.359
1713	0.700			1.350	1.515		0.714	0.580					1.095						0.751						0.834	1.230			0.808

YEAR	POLDF	POLWF	FLEDF	FLEWF	LAJDF	LAJWF	ALADF	ALAWF	BARDF	BARWF	EFKDF	EFKWF	LEFDF	LEFWF	LOGDF	LOGWF	WVADF	WVAWF	PEHDF	PEHWF	FWNDF	FWNWF	REDDF	REDWF	BONDF	BONWF	SRRDF	SRRWF	RTCDF
1714	0.741			1.256	1.548		0.737	0.710					1.021						1.262						1.267	1.364			0.997
1715	1.216			1.207	1.433		0.907	0.805					1.218						1.532						1.345	1.444			1.072
1716	0.929			1.469	1.086		0.789	0.798					1.041						0.833						1.019	0.951			0.717
1717	0.581			1.326	1.178		1.131	1.162					1.075						0.369						1.058	0.934			0.919
1718	0.529			1.198	1.212		0.968	0.902					0.804						0.186						0.765	0.825			0.886
1719	0.859			1.339	0.962		1.045	1.136					1.052		1.031				0.943						1.213	1.480			1.168
1720	0.498			1.250	0.983		0.676	0.845					1.063		0.691				0.310						0.351	0.885			0.484
1721	1.046		0.858	1.521	1.325		0.993	0.957					1.478		0.700				0.631						0.590	1.211			0.724
1722	1.117		0.595	0.944	1.253		0.661	0.543					1.276		0.679				0.640						0.527	1.074			0.834
1723	0.452		0.537	0.603	0.710		0.512	0.513					1.278		0.579				0.928						0.513	1.148			0.660
1724	0.488		0.805	1.261	1.056		0.410	0.380					1.092		1.185				1.413						0.634	1.284			0.618
1725	0.321		0.603	0.999	0.779		0.469	0.496					1.234		1.166				0.570						1.042	1.336			1.123
1726	0.564		0.509	0.694	1.193		0.600	0.491					1.173		0.844				0.000						0.496	0.933			1.070
1727	0.680		0.391	0.776	0.847		0.523	0.456					1.348		1.003				0.367						1.024	1.122			1.202
1728	0.827		0.648	1.166	0.942		0.867	0.942					0.798		0.999				0.557						1.046	1.437			1.057
1729	0.868		1.031	1.267	1.014		0.750	0.814					1.045		1.310				1.425						1.112	1.095			0.969
1730	0.916		1.250	1.213	0.543		0.748	0.804					0.889		1.222				0.837						1.099	1.398			1.223
1731	1.233		1.413	1.296	0.530		0.754	0.777					1.297		1.309				0.929						0.846	1.297			0.853
1732	1.190		1.286	1.083	0.602		0.878	0.895					1.470		1.260				0.972						0.994	1.421			0.947
1733	1.004		1.151	1.237	0.806		0.896	0.837					1.481		1.577				1.769						1.355	1.426			1.101
1734	0.850		0.974	1.018	0.404		0.836	0.883					1.159		1.106				1.154						0.531	0.802			0.578
1735	1.105		1.219	1.305	0.807		1.180	1.137					1.079		1.429				1.977						1.145	1.214			1.001
1736	0.787		1.075	1.398	0.506		1.132	0.949					1.126		1.056				1.010						0.700	1.213			0.841
1737	0.719		1.115	1.223	0.731		0.833	0.756					1.047		1.067				1.290						1.156	1.397			1.098
1738	0.778		1.043	1.107	0.328		0.679	0.609	1.547				0.702		1.160				1.247						1.035	1.058			0.907
1739	1.377		1.448	1.323	1.017		1.284	1.219	1.139				1.258		1.192				1.718						0.860	1.099			0.813
1740	1.028		1.163	1.386	0.659		0.960	0.883	0.643				1.389		0.952				0.952						1.063	1.069			0.980
1741	1.224		1.033	1.267	0.873		1.186	1.124	0.432				1.278		1.144				1.046						1.251	1.295			1.056
1742	1.217		0.859	1.173	0.809		1.096	0.979	0.997				1.356		0.876				1.050						1.208	0.916			0.903
1743	1.256		1.247	1.299	0.511		1.113	0.938	0.233				0.818		0.633				0.651						0.942	0.794			1.054
1744	1.208		1.127	1.062	0.634		1.065	0.758	1.106				1.069		0.886				1.128						1.401	1.065			1.244
1745	1.163		0.867	1.020	0.752		1.298	1.060	0.934				0.618		0.778				0.893						1.036	0.831			1.183
1746	0.963		0.451	0.788	0.669		0.744	0.722	0.279				0.463		0.599				0.376					1.640	0.656	0.756			1.015
1747	1.036		0.841	0.748	0.730		0.906	0.718	0.314				0.586		0.486				0.170					1.713	0.842	0.507			1.073
1748	1.145		1.199	1.075	1.324		0.960	0.947	1.400				1.142		1.166				1.164					1.872	1.119	0.897			1.160
1749	0.521		0.509	0.537	0.404		0.413	0.350	••••••				0.544		0.675				0.308					0.888	0.562	0.522			0.875
1750	0.653		0.956	0.927	0.534		0.672	0.624	1.301				1.127		1.357				1.350					1.366	1.077	0.874			1.126
1751	0.792		0.995	0.978	0.578		0.996	0.999	0.497				0.858		0.954				0.949					0.862	0.683	0.542			1.092

YEAR	POLDF	POLWF	FLEDF	FLEWF	LAJDF	LAJWF	ALADF	ALAWF	BARDF	BARWF	EFKDF	EFKWF	LEFDF	LEPWF	LOGDF	LOGWF	WVADF	WVAWF	PEHDF	PEHWF	FWNDF	FWNWF	REDDF	REDWF	BONDF	BONWF	SRRDF	SRRWF	RTCDF
1752	1.053		1.143	0.881	1.068		1.104	1.042	1.416				0.905		1.222				1.934					1.847	1.195	1.189			1.002
1753	0.878		0.964	0.887	0.724		1.045	1.129	0.615				1.258		0.928				1.277					1.293	0.781	0.488			1.268
1754	0.531		0.738	0.694	0.560		0.718	0.611	0.428				0.679		0.746				0.990					0.991	0.763	0.279			1.169
1755	0.673		0.848	0.958	0.654		0.863	0.805	0.786				0.796		0.843				1.255					0.984	0.749	0.000			1.269
1756	1.213		1.035	0.966	1.264		1.158	1.060	1.076				0.939		1.181				1.465	1.627				1.304	0.920	0.253			0.875
1757	1.208		1.130	1.011	1.190		0.966	1.116	1.160				0.943		1.528				1.690	1.690				1.392	0.738	0.000			0.934
1758	1.073		1.306	0.948	0.842		1.178	1.222	0.646				0.528		0.951				1.010	1.194				1.248	0.976	0.289			0.935
1759	1.296		1.284	1.114	1.226		1.386	1.366	0.521				0.406		0.916				0.992	1.189				1.406	1.034	0.557			1.138
1760	1.210		0.996	0.921	1.095		1.196	1.262	0.898				0.521		1.048				1.246	1.441				1.233	0.982	0.364	0.853	0.516	0.907
1761	0.731		1.088	0.671	1.309		1.027	0.946	0.656				0.100		0.709				0.604	1.051				1.050	0.379	0.000	0.411	0.221	0.875
1762	0.654		0.662	0.647	1.384		0.948	0.682	0.629				0.326		0.510				0.450	0.430				1.135	0.929	0.000	0.784	0.663	1.029
1763	1.213		0.921	0.872	1.467		1.080	0.950	1.116				0.755		0.995				1.125	1.359				1.316	1.056	0.363	0.900	0.890	0.869
1764	0.105		0.535	0.275	0.927		0.622	0.536	0.756				0.973		0.746				0.682	0.674				1.121	0.768	0.015	0.654	0.659	1.101
1765	0.647		0.915	0.482	1.375		1.068	0.772	1.037				1.175		0.903				0.845	0.883			2.048	1.486	1.180	0.648	1.361	1.281	1.229
1766	0.515		0.963	0.539	1.457		1.123	0.889	1.234				0.612		0.680				0.445	0.379			1.195	0.386	0.575	0.000	0.680	0.537	1.109
1767	0.646		0.825	0.548	1.927		1.282	1.018	0.785		0.431		0.648		0.648				0.670	0.432			1.102	0.859	0.779	0.000	1.030	0.931	0.661
1768	0.700		0.914	0.944	2.608		1.310	1.201	0.804		0.330		1.144		0.667			1.181	0.546	0.534			1.071	0.256	0.561	0.000	0.707	0.589	0.984
1769	0.533		0.846	0.890	1.698		1.030	1.114	1.055		0.717		1.449		0.924			1.527	0.897	0.927			1.425	0.600	0.703	0.055	0.866	0.883	1.016
1770	0.491		0.864	0.942	2.022		1.058	1.135	0.811		0.493		1.207		0.891			1.361	1.072	0.835			1.102	0.829	0.772	0.249	0.864	0.816	1.043
1771	0.226		1.084	0.769	1.575		1.041	1.102	1.167		0.444		1.447		0.850			1.099	0.770	0.631			0.797	0.277	0.311	0.000	0.332	0.431	0.846
1772	0.659		0.710	0.791	1.455		0.985	1.083	0.984		0.697		1.310		0.865			1.101	0.892	0.778			0.697	0.628	0.735	0.174	0.712	0.826	0.942
1773	0.532		0.951	0.477	0.992		0.629	0.649	1.011		1.033		1.109		1.015			1.234	1.397	1.208			0.996	0.562	0.524	0.038	0.515	0.468	0.704
1774	0.340		0.706	0.659	0.638		0.596	0.753	1.121		0.910		1.035		0.939			1.206	0.790	0.428			1.437	1.055	0.859	0.508	1.131	0.936	0.989
1775	0.666		0.670	0.671	1.169		0.717	0.810	1.152		1.099		1.038		1.202			0.994	1.021	0.709			1.330	1.369	1.175	1.061	1.594	1.555	1.303
1776	0.638		0.900	0.880	1.082		0.870	1.010	1.412		0.924		0.837		1.058			1.378	0.639	0.628			1.054	1.472	0.589	0.360	1.024	0.969	0.966
1777	0.899		0.915	0.861	1.185		1.115	1.204	1.174		1.121		0.984		1.299			1.123	0.971	1.099			1.222	1.571	0.852	0.548	1.248	1.216	1.114
1778	0.846		0.892	0.819	0.841		1.022	1.048	1.109		1.042		0.910		1.307			1.264	1.007	1.029			0.944	1.360	0.935	0.565	1.030	1.012	0.691
1779	1.008		0.960	0.839	1.172		0.988	1.097	1.102		1.064		0.864		1.232			1.452	1.173	1.128			1.429	1.768	1.207	1.095	1.435	1.299	1.231
1780	1.363		1.166	1.111	1.290		1.120	1.314	1.121		1.214		1.000		1.331			1.290	1.351	1.385			1.229	1.336	0.991	0.918	1.386	1.403	1.167
1781	1.211		1.210	0.981	1.101		0.929	1.106	1.327		1.177		0.949		1.332			1.110	1.260	1.524			1.251	1.372	1.055	0.976	1.360	1.489	1.089
1782	1.569		1.715	1.011	1.419		1.407	1.552	1.529		1.414		0.889		1.147			0.808	1.224	1.342			1.250	1.326	1.041	0.617	0.963	0.971	1.008
1783	1.372		1.398	0.849	1.436		1.199	1.181	1.178		0.910	1.374	0.656		1.037			1.180	0.798	0.804			1.194	1.487	1.067	0.367	0.865	0.916	0.840
1784	1.052		1.217	0.778	1.116		1.187	0.978	1.017		0.762	1.202	0.681		0.967			1.371	0.729	0.732			1.103	1.453	0.996	0.386	1.047	1.189	1.078
1785	1.322		1.243	1.032	1.173		1.253	1.234	1.100		1.270	1.732	1.110		1.256			1.230	1.199	1.128			0.989	1.191	1.236	0.751	1.042	1.126	1.269
1786	0.943		1.215	0.777	0.768		0.897	1.046	1.321		1.338	1.723	0.905		1.193			0.845	1.497	1.117			1.244	1.241	1.083	0.686	1.268	1.387	1.132
1787	0.986		1.381	0.899	1.056		1.085	1.057	0.800		0.809	0.412	0.797		0.926			0.607	0.722	0.490			1.347	1.225	1.236	0.585	1.215	1.378	1.236
1788	0.909		1.303	0.963	0.661		1.044	1.045	1.174	0.961	1.125	0.320	0.831		1.248			0.694	1.330	0.868			0.888	0.672	1.325	0.301	1.060	1.149	0.946
1789	0.977		1.499	0.992	0.857		0.750	0.868	1.092	1.444	1.264	0.665	0.984		1.315			0.666	1.577	1.309			1.090	0.869	1.376	0.634	1.160	1.292	0.866

YEAR	POLDF	POLWF	FLEDF	FLEWF	LAJDF	LAJWF	ALADF	ALAWF	BARDF	BARWF	EFKDF	EFKWF	LEFDF	LEFWF	LOGDF	LOGWF	WVADF	WVAWF	PEHDF	PEHWF	FWNDF	FWNWF	REDDF	REDWF	BONDF	BONWF	SRRDF	SRRWF	RTCDF
1790	1.062		1.790	1.140	1.071		1.405	1.393	0.719	0.732	0.827	0.235	0.636		1.023			0.745	0.855	0.567			1.192	1.217	1.235	0.401	1.367	1.414	0.990
1791	0.752		1.418	0.881	1.043		1.153	0.954	0.906	0.930	1.010	0.331	1.082		1.122			0.838	1.221	0.797			1.120	0.712	0.934	0.000	0.839	1.047	1.109
1792	0.997		1.263	1.106	1.105		1.110	1.032	0.749	1.084	1.175	0.351	0.970		1.155			0.937	1.155	0.783			0.800	0.829	1.028	0.247	1.012	1.297	1.052
1793	0.488		0.947	0.519	0.703		0.742	0.813	0.576	0.428	0.508	******	0.678		0.947			1.168	0.543	0.110			0.893	0.350	0.487	0.000	0.616	0.888	0.621
1794	0.807		0.988	0.486	0.981		0.856	0.582	0.755	0.536	0.750	0.766	1.065		1.083			0.617	0.999	0.733			1.246	0.685	0.852	0.533	0.971	1.104	0.987
1795	0.136		0.605	0.231	0.737		0.637	0.438	0.696	0.786	0.693	0.596	1.172		0.973			0.938	0.833	0.670			0.925	0.758	0.828	0.421	0.932	1.063	0.856
1796	0.194		0.532	0.388	0.807		0.820	0.765	0.859	1.374	0.923	0.843	1.160		1.044			0.883	1.151	1.043			0.725	0.488	0.610	0.123	0.627	0.732	0.633
1797	0.630		0.718	0.533	1.023		1.172	1.094	1.084	1.398	1.091	1.064	1.296		1.095			0.882	1.275	1.190			1.188	1.235	1.294	1.029	1.296	1.302	1.195
1798	0.378		0.552	0.577	0.751		0.975	0.787	0.853	1.500	1.006	1.106	0.951		1.009			1.093	1.204	1.183			0.928	0.870	0.838	0.548	0.952	1.027	0.833
1799	0.258		0.723	0.801	0.540		0.477	0.589	0.658	0.901	0.738	0.669	0.766		0.920			1.109	0.897	0.879			0.911	0.826	0.704	0.399	0.857	1.036	0.863
1800	0.387		0.594	0.522	0.888		0.827	0.607	0.693	0.157	0.755	0.625	0.815		0.936		0.966	0.955	0.850	0.786			1.101	0.678	0.542	0.048	0.757	0.925	0.974
1801	1.148		1.060	0.987	1.324		1.173	1.122	0.876	0.400	1.147	0.938	1.288		1.122		1.104	1.041	1.275	1.321			1.231	0.893	1.116	0.824	1.078	1.135	0.987
1802	0.549		0.786	0.616	0.679		0.732	0.724	0.847	0.227	0.834	0.792	1.016		1.058		0.772	0.965	0.946	1.098			0.898	0.912	0.786	0.662	1.261	1.249	0.946
1803	0.350		0.864	0.543	0.816		0.669	0.716	0.529	0.575	0.547	0.517	0.781		0.869		0.437	0.409	0.661	0.927			1.053	0.836	0.447	0.285	1.092	1.131	0.757
1804	0.683		0.838	0.908	1.129		1.027	1.030	0.645	1.098	0.746	0.706	1.118		0.962		0.729	0.813	0.804	1.178			0.659	0.736	0.682	0.331	1.053	1.094	0.877
1805	0.431		0.762	0.656	0.941		0.707	0.538	0.853	1.121	1.049	1.510	1.166		1.154		0.988	1.211	1.460	1.718			0.939	0.883	1.158	0.881	1.600	1.479	0.876
1806	0.612		0.867	0.539	1.190		0.587	0.573	0.844	0.905	0.953	1.286	1.285		1.056		1.091	1.008	1.205	1.346			0.977	0.784	1.083	0.845	1.338	1.206	1.064
1807	0.774		0.929	0.795	0.972		1.293	1.020	0.763	0.861	0.916	1.107	1.243		0.421		1.233	1.392	0.981	1.122			0.628	0.526	0.596	0.217	1.110	0.872	0.904
1808	0.835		1.137	0.962	1.180		1.278	1.183	0.734	1.065	1.064	1.382	1.623		0.667		1.295	1.172	1.105	1.464			0.872	0.917	0.873	0.582	1.059	0.996	0.863
1809	0.851		0.786	0.715	0.834		1.088	0.961	0.825	0.950	1.165	1.366	1.079		0.825		1.031	1.013	1.250	1.480			1.011	0.866	0.979	0.870	1.066	0.965	0.987
1810	0.482		0.935	0.734	0.611		1.073	1.025	0.970	0.865	1.282	1.541	1.100		0.794		0.903	0.862	1.230	1.532			0.946	0.955	0.996	0.806	1.154	1.149	1.227
1811	0.634		0.865	0.718	0.735		1.079	1.026	1.099	1.282	1.138	1.139	0.993		0.778		1.111	0.903	1.116	1.378			0.765	0.771	0.757	0.718	0.784	0.867	1.230
1812	0.318		0.886	0.473	0.577		1.007	0.705	1.089	1.473	1.149	1.063	1.013		0.937		0.894	0.928	1.140	1.426			0.889	0.754	0.968	0.640	1.224	0.984	1.315
1813	0.059		0.668	0.345	0.349		0.852	0.552	1.281	1.410	1.239	1.315	0.902		1.048		1.021	0.878	1.199	1.532			0.827	0.623	0.751	0.623	0.972	0.905	1.105
1814	0.667		0.918	0.746	0.765		1.274	1.185	1.381	1.406	1.260	1.502	0.842		1.269		1.107	1.003	1.389	1.756			0.830	0.813	0.862	0.785	0.971	0.905	1.130
1815	0.042		0.515	0.289	0.254		0.629	0.535	1.338	1.574	0.929	0.844	0.720		1.078		1.207	1.120	0.690	1.121			0.674	0.661	0.680	0.599	0.850	0.926	0.997
1816	0.064		0.480	0.407	0.552		0.940	0.843	1.247	1.732	0.955	0.758	1.013		1.081		1.293	1.571	0.697	1.075			0.622	0.481	0.782	0.728	0.997	1.128	1.096
1817	0.249		0.552	0.714	1.053		0.976	0.866	1.221	1.522	0.955	1.206	1.060		1.136		1.240	1.239	1.006	1.367			0.507	0.442	0.674	0.637	0.708	0.809	0.869
1818	0.555		0.529	0.589	0.813	0.622	0.588	0.619	1.219	0.999	1.095	1.616	1.162		1.210		1.337	1.159	1.224	1.614			0.845	0.769	1.026	1.034	0.996	1.023	0.990
1819	0.496		0.512	0.627	0.766	0.683	0.893	0.972	1.341	1.304	0.847	1.531	0.882		0.921		1.129	0.937	0.760	1.288			0.621	0.517	0.763	0.821	0.626	0.686	0.864
1820	0.556		0.631	0.796	0.996	1.113	0.865	1.134	1.398	1.101	0.930	1.419	1.130		0.998		1.441	1.104	0.740	1.220			0.632	0.780	0.660	0.797	0.780	0.760	1.047
1821	0.785		0.772	0.871	1.064	1.191	1.063	1.197	1.546	1.203	0.844	1.099	1.127		0.923		1.438	1.295	0.621	1.117			0.448	0.605	0.863	0.770	0.990	0.948	1.668
1822	0.962		0.899	0.815	1.080	1.082	0.778	0.844	1.208	1.000	0.939	1.223	1.095		0.796		1.250	1.153	0.992	1.191			0.287	0.451	0.556	0.440	0.328	0.473	0.898
1823	0.762		0.913	0.931	0.920	1.053	0.901	1.145	1.691	1.037	1.041	1.388	1.105		0.824		1.365	1.132	0.959	1.284			0.578	1.078	0.804	0.912	1.041	1.206	1.197
1824	0.939		0.816	0.939	1.159	1.147	0.906	1.023	1.335	1.176	0.974	0.980	1.077	1.874	0.785		1.239	1.217	0.681	0.991			0.712	0.967	0.815	0.847	1.090	1.205	1.063
1825	0.800		0.745	0.853	0.933	1.222	0.912	1.004	1.117	1.006	0.942	0.958	0.886	1.253	0.703		1.053	1.136	0.589	0.885			0.269	0.699	0.405	0.567	0.741	0.985	0.747
1826	1.029		0.571	0.667	0.951	0.778	1.030	1.138	1.113	1.032	1.244	1.164	1.094	1.143	0.904		1.082	1.088	0.716	0.909			0.594	0.819	0.618	0.861	1.044	1.176	0.834
1827	0.712		0.511	0.607	0.584	0.677	0.863	0.797	1.259	0.844	1.029	0.964	1.117	0.881	0.826		0.881	0.793	0.692	0.722			0.514	0.499	0.491	0.552	0.708	0.821	0.836

YEAR	POLDF	POLWF	FLEDF	FLEWF	LAJDF	LAJWF	ALADF	ALAWF	BARDF	BARWF	EFKDF	EFKWF	LEFDF	LEFWF	LOGDF	LOGWF	WVADF	WVAWF	PEHDF	PEHWF	FWNDF	FWNWF	REDDF	REDWF	BONDF	BONWF	SRRDF	SRRWF	RTCDF
1828	0.994		0.598	0.589	0.911	0.790	0.792	0.625	1.230	1.094	1.184	0.772	1.161	0.935	0.753		1.001	1.060	0.302	0.350			0.480	0.484	0.462	0.504	1.028	1.127	0.870
1829	0.912		0.755	0.647	0.792	0.736	0.942	0.979	1.195	0.941	1.066	1.256	0.915	0.826	0.940		0.922	0.953	0.774	0.708			0.507	0.572	0.691	0.630	0.733	0.714	0.822
1830	1.012		1.033	0.812	1.115	0.885	1.024	1.040	0.981	0.645	1.145	0.868	0.963	0.847	0.911		0.943	1.150	0.430	0.294			0.638	0.516	0.773	0.620	1.050	0.962	0.839
1831	0.940		0.803	0.564	1.075	1.069	1.149	1.089	1.471	0.990	1.166	0.977	1.045	1.015	0.915		1.097	0.994	0.545	0.419			0.446	0.388	0.520	0.166	0.526	0.423	0.989
1832	0.676		0.633	0.432	0.792	1.063	0.941	0.802	1.226	0.849	1.035	1.127	0.924	0.803	0.956		0.862	0.992	0.469	0.311			1.300	1.063	1.055	1.145	1.278	1.063	1.403
1833	0.785		0.707	0.672	0.934	1.207	1.083	0.943	1.071	1.425	1.161	1.054	0.847	0.560	0.995		1.183	1.164	0.533	0.332			0.883	0.638	0.712	0.624	0.736	0.627	1.137
1834	0.591		0.665	0.532	1.028	1.280	1.094	0.982	1.202	1.147	1.167	1.136	1.017	0.876	1.093		1.381	1.544	0.810	0.581			1.206	0.750	0.918	0.753	0.970	0.737	1.066
1835	0.354		0.617	0.312	1.353	1.034	0.953	0.714	1.643	1.195	1.201	1.338	0.966	0.819	1.119		1.064	1.145	0.921	0.650			0.794	0.296	0.511	0.379	0.594	0.402	0.855
1836	0.744		0.718	0.707	1.260	0.822	0.948	0.836	1.463	1.158	1.003	1.031	0.963	0.864	1.117		1.167	1.029	1.020	0.798			1.511	0.920	1.103	1.084	1.089	0.842	0.986
1837	0.742		0.750	0.730	1.355	1.244	1.271	1.070	1.139	0.862	1.261	1.016	1.074	1.108	1.163		1.111	1.002	0.987	0.742			1.463	0.558	0.863	0.632	1.173	0.867	1.067
1838	0.399		0.514	0.386	0.887	1.228	0.970	0.668	1.179	0.832	1.011	0.665	0.817	0.778	1.111		1.124	1.032	0.786	0.589			1.348	0.418	0.653	0.454	0.997	0.613	0.923
1839	0.324		0.388	0.281	0.777	1.320	0.632	0.442	0.832	0.947	0.792	0.302	0.631	0.767	0.656		0.786	0.748	0.415	0.251			1.481	0.628	0.827	0.645	1.313	0.799	1.203
1840	0.478	0.504	0.424	0.276	0.758	0.964	0.566	0.432	0.829	0.500	0.658	0.540	0.638	0.492	0.524		0.871	0.732	0.416	0.244			1.121	0.569	0.833	0.737	0.931	0.455	1.252
1841	0.706	0.493	0.665	0.490	0.814	1.178	0.837	0.722	1.094	0.694	0.729	0.301	0.962	0.727	0.823		0.702	0.698	0.590	0.465			0.985	0.674	0.928	0.726	0.998	0.786	0.929
1842	1.413	1.131	1.151	0.939	1.410	1.212	1.185	1.266	1.098	0.753	1.171	0.905	1.194	0.832	0.883		0.915	0.953	1.144	1.171			1.080	0.761	0.972	1.081	0.916	0.848	0.999
1843	1.241	0.451	1.125	0.693	1.574	1.381	1.142	1.120	0.972	0.565	1.044	0.711	0.957	1.063	0.919		0.954	0.815	1.092	1.058			1.840	0.944	1.381	1.210	1.081	0.835	1.756
1844	0.937	0.495	1.088	0.611	1.196	1.423	1.233	1.114	0.811	0.489	0.864	0.597	0.903	1.184	0.856		0.824	0.641	0.696	0.688			1.522	0.537	1.192	0.871	0.834	0.744	1.596
1845	1.299	1.112	1.099	0.990	1.396	1.327	1.237	1.282	0.947	0.572	1.078	0.895	0.997	0.756	1.157		0.840	0.705	1.081	1.093			1.090	0.776	1.054	1.010	0.937	0.662	1.069
1846	0.899	0.617	0.950	0.788	0.841	0.758	0.631	0.668	1.102	0.661	0.841	0.656	0.772	0.888	1.056		0.719	0.623	0.766	0.897			0.854	0.666	1.183	1.098	0.952	0.834	0.788
1847	1.190	1.100	0.959	0.911	1.382	1.085	0.930	1.053	1.018	1.039	1.011	0.988	1.197	1.047	1.114		1.152	1.078	1.294	1.517			0.974	0.808	0.974	0.983	1.059	0.937	1.009
1848	1.121	0.967	0.874	0.817	1.239	1.104	1.093	1.094	0.889	1.041	0.952	0.778	0.849	0.812	1.012		0.843	0.718	0.972	1.166			0.903	0.768	1.061	0.989	1.170	0.976	1.053
1849	0.771	0.539	0.771	0.639	1.005	1.130	0.783	0.830	0.811	1.277	0.843	0.687	0.858	1.071	0.980		0.879	0.928	0.881	1.007			1.079	0.976	1.094	1.107	1.314	1.204	0.908
1850	0.832	0.809	0.980	0.799	1.098	0.852	0.849	0.908	1.137	1.602	0.931	0.939	0.996	1.098	1.095		1.256	0.963	1.104	1.236			0.784	0.695	0.896	0.847	1.086	0.995	0.735
1851	1.059	0.691	0.948	0.869	1.187	1.060	0.908	1.025	1.235	1.394	1.010	1.105	1.185	1.090	1.162		1.163	1.155	1.366	1.512			1.148	1.153	1.127	1.133	1.167	0.989	0.978
1852	0.649	0.696	0.937	0.575	0.802	0.674	0.725	0.769	0.954	1.083	0.739	0.491	0.954	0.877	1.037		0.642	0.786	0.805	0.999		0.843	0.483	0.596	0.939	0.774	0.733	0.780	1.028
1853	1.043	0.920	0.888	0.743	1.371	1.096	1.109	0.996	0.936	0.920	0.686	0.962	1.051	0.851	1.284		0.580	0.743	1.192	1.299		1.101	1.185	1.033	1.218	1.133	1.337	1.118	1.005
1854	0.813	0.884	1.152	0.658	1.136	1.005	1.164	1.094	0.882	0.702	0.776	1.190	0.729	0.954	1.203		0.623	0.948	1.064	1.279		1.152	1.189	1.229	1.223	1.136	0.983	1.101	1.174
1855	0.787	0.811	0.790	0.519	0.884	1.091	0.841	0.835	0.964	1.067	0.887	1.354	1.368	1.228	1.110		0.722	0.883	0.989	1.186		1.096	1.045	1.237	1.123	1.136	1.276	0.963	1.301
1856	0.624	0.858	0.980	0.370	0.603	0.846	0.719	0.807	0.982	0.978	0.981	1.244	1.252	1.092	1.137		0.740	0.999	0.959	0.927	0.737	0.858	0.535	0.980	1.086	0.935	1.026	0.795	0.839
1857	0.718	0.683	0.975	0.494	0.600	1.049	0.879	1.120	0.996	1.023	1.198	1.324	1.092	1.087	1.389		0.841	0.934	1.327	1.295	1.180	1.185	0.915	1.283	1.222	1.335	1.143	1.039	1.016
1858	0.072	0.565	0.556	0.039	0.394	0.763	0.377	0.552	0.861	0.468	1.037	0.880	0.931	0.874	1.158		0.746	0.969	0.888	0.794	0.292	0.669	0.565	0.687	0.753	1.054	0.936	0.887	0.780
1859	0.870	1.115	0.827	0.705	1.010	1.203	1.101	1.243	1.261	1.097	1.221	1.287	1.099	1.038	1.173		1.001	0.990	1.235	0.999	1.440	1.273	1.276	1.215	1.247	1.565	1.622	1.342	1.138
1860	0.304	0.650	0.579	0.198	0.416	0.620	0.683	0.613	1.032	1.023	1.141	1.224	1.095	1.031	1.139		0.803	0.807	1.336	1.091	1.209	1.073	1.141	1.009	1.491	1.457	1.298	0.955	1.067
1861	0.886	0.828	1.114	0.822	1.029	0.888	0.780	0.913	1.087	1.187	1.254	1.310	1.269	1.142	1.086		1.114	1.058	1.468	1.208	1.780	1.290	1.132	1.001	1.309	1.329	1.007	0.948	0.935
1862	0.597	0.793	0.589	0.267	0.689	0.561	0.897	0.885	0.973	0.940	1.093	1.032	1.033	1.045	1.160		0.967	0.819	1.200	0.922	1.016	1.040	0.969	0.976	1.358	1.243	1.335	1.031	1.286
1863	0.967	0.850	0.945	0.594	0.919	0.837	1.144	1.172	0.968	1.115	1.116	0.839	1.064	0.866	1.205		0.852	0.849	0.945	0.860	1.077	1.004	0.888	0.979	1.149	1.183	1.112	0.934	1.004
1864	1.183	1.196	0.973	0.699	1.231	1.043	1.306	1.413	1.076	1.150	1.034	0.974	1.074	1.001	1.083		0.905	1.006	1.081	0.875	0.844	1.005	0.592	0.801	0.902	1.051	0.534	0.582	1.218
1865	1.227	0.973	0.845	0.731	1.081	0.979	1.388	1.269	0.932	1.121	1.223	0.846	1.047	1.136	1.099	1.095	0.880	0.865	1.079	0.885	1.278	1.248	1.145	1.232	1.196	1.318	1.221	1.046	1.192

YEAR	POLDF	POLWF	FLEDF	FLEWF	LAJDF	LAJWF	ALADF	ALAWF	BARDF	BARWF	EFKDF	EFKWF	LEFDF	LEFWF	LOGDF	LOGWF	WVADF	WVAWF	PEHDF	PEHWF	FWNDF	FWNWF	REDDF	REDWF	BONDF	BONWF	SRRDF	SRRWF	RTCDF
1866	1.251	1.060	0.954	0.609	0.906	1.018	1.544	1.316	0.902	1.258	1.458	0.811	1.196	1.281	1.402	1.007	1.011	0.968	1.153	0.903	0.809	1.073	1.101	1.090	1.243	1.151	0.943	0.809	0.980
1867	1.485	1.119	1.087	0.863	1.021	0.946	1.563	1.342	1.021	1.346	1.227	0.719	1.155	1.260	1.237	1.055	1.170	0.959	1.078	0.822	0.636	0.981	1.352	1.188	1.217	1.183	1.424	1.020	1.259
1868	0.881	0.877	0.834	0.479	0.603	0.712	0.867	0.775	0.870	1.110	1.103	0.928	0.929	0.852	1.091	0.747	1.035	0.988	0.901	0.818	1.003	1.117	1.307	1.397	1.326	1.523	1.444	1.199	0.936
1869	1.313	0.820	1.136	0.801	0.975	0.824	1.349	1.211	1.100	1.314	1.281	1.025	1.338	0.993	1.375	0.702	1.282	0.968	1.066	0.961	0.627	0.861	1.266	1.216	1.218	1.279	1.430	1.073	0.932
1870	1.415	0.752	1.114	0.887	0.998	1.026	1.090	1.233	0.969	0.813	1.053	1.012	1.037	0.574	0.979	0.652	0.902	0.834	0.990	0.954	1.007	0.999	1.215	1.224	1.002	1.354	0.648	0.692	0.416
1871	1.430	0.814	1.261	1.036	0.977	0.871	1.303	1.419	0.881	0.641	1.230	1.230	0.992	0.750	0.990	0.756	0.935	0.925	0.969	1.030	1.346	1.149	1.289	1.318	1.316	1.561	1.242	1.038	0.959
1872	1.094	0.457	1.122	0.767	0.778	0.673	0.738	1.043	0.875	0.832	0.818	0.955	0.723	0.629	0.765	0.618	1.073	0.830	0.566	0.787	0.237	0.549	0.606	0.795	0.628	0.932	0.721	0.674	0.268
1873	1.755	1.011	1.499	1.373	1.405	1.267	1.348	1.748	0.799	0.699	1.046	1.253	0.812	0.570	0.964	0.884	0.926	0.822	0.817	0.934	1.277	0.918	1.442	1.461	1.268	1.480	0.658	0.684	1.094
1874	1.262	0.890	1.081	0.883	1.176	1.005	1.088	1.194	0.846	0.791	0.968	0.911	0.975	0.629	0.896	0.740	0.723	0.681	0.761	0.787	1.042	0.992	1.165	1.208	1.160	1.367	1.224	1.072	0.925
1875	1.065	0.928	0.962	0.857	0.830	1.006	0.742	0.987	0.935	0.857	0.900	0.897	1.080	0.728	0.875	0.989	0.792	0.618	0.735	0.749	1.268	1.054	1.154	1.160	1.153	1.410	1.141	1.085	0.736
1876	1.356	0.960	1.061	0.924	1.151	1.067	1.033	1.155	1.089	0.825	1.246	1.132	1.242	0.981	0.989	1.070	0.659	0.638	1.170	1.117	0.903	0.812	1.177	0.976	1.039	1.299	0.938	0.920	0.363
1877	1.071	0.678	1.044	0.723	0.809	0.925	0.831	1.000	1.034	1.060	1.044	0.863	1.092	0.913	0.859	0.888	0.754	0.743	0.774	0.961	1.078	0.930	0.993	1.034	0.926	1.201	0.663	0.704	0.927
1878	1.113	0.535	1.123	0.781	0.528	0.734	0.814	0.857	0.825	0.895	1.105	1.174	1.059	0.872	1.011	1.129	0.796	0.828	1.113	1.160	0.367	0.558	0.588	0.724	0.746	0.947	0.672	0.745	0.571
1879	1.269	0.857	0.896	0.828	0.817	1.011	0.911	1.258	0.909	1.031	1.065	1.059	1.018	0.837	1.158	1.238	0.936	0.967	1.300	1.189	0.942	0.798	0.923	1.043	1.052	1.022	0.657	0.621	0.631
1880	1.074	0.736	1.119	1.152	0.985	1.067	0.891	1.137	1.045	1.091	1.068	1.211	1.261	1.237	1.275	1.487	1.325	1.277	1.380	1.318	1.398	0.975	1.120	1.297	1.325	1.267	0.857	0.873	0.646
1881	0.863	0.602	0.887	0.973	0.677	0.986	0.873	1.065	0.933	0.866	1.167	1.240	1.111	0.984	1.250	1.423	0.936	1.159	1.386	1.428	0.951	0.876	0.750	0.919	1.142	0.953	1.003	0.875	0.858
1882	1.406	0.955	1.070	1.142	1.158	1.160	1.064	1.202	0.782	0.825	1.003	0.873	0.972	1.057	0.923	0.956	0.759	1.256	1.016	1.018	0.211	0.596	0.484	0.582	0.797	0.632	0.564	0.679	0.467
1883	1.869	1.098	0.997	1.064	1.334	1.288	1.144	1.254	0.889	0.884	1.160	1.210	1.006	1.122	0.975	1.032	0.770	1.377	1.227	1.167	1.202	0.979	1.188	1.285	1.277	1.116	0.913	0.991	1.029
1884	1.323	0.775	0.655	0.784	0.973	1.115	1.161	1.386	0.800	1.037	0.959	1.134	0.836	0.921	0.924	0.877	0.679	1.101	1.048	1.155	0.621	0.750	0.713	1.017	0.933	0.957	0.976	1.098	0.742
1885	1.206	0.524	0.394	0.569	0.857	0.918	0.767	1.039	0.606	1.139	0.894	1.024	0.660	0.838	0.814	0.723	0.508	0.980	0.719	0.737	0.455	0.661	0.584	0.861	0.851	0.846	1.032	1.321	0.471
1886	1.515	0.917	0.864	1.010	1.255	1.103	0.913	1.266	0.786	0.980	0.880	0.878	0.990	0.771	0.960	0.708	0.882	0.877	0.787	0.653	0.985	0.892	0.895	1.144	1.156	1.136	1.366	1.241	0.754
1887	0.506	0.381	0.376	0.461	0.400	0.449	0.253	0.324	0.337	0.353	0.652	0.702	0.789	0.534	0.853	0.492	0.612	0.556	0.436	0.290	0.114	0.474	0.438	0.606	0.661	0.635	0.711	0.607	0.469
1888	0.610	0.742	0.594	0.862	0.602	0.705	0.435	0.526	0.678	0.846	0.830	0.829	0.917	0.721	1.022	0.715	0.840	0.747	0.617	0.356	1.149	1.053	1.034	1.206	1.265	1.252	1.364	1.139	1.087
1889	1.255	1.124	0.954	1.341	0.656	0.782	0.753	0.816	0.629	0.574	0.865	0.807	0.819	0.743	1.131	0.781	0.727	0.734	0.728	0.536	1.015	1.005	1.003	1.136	1.158	1.068	1.230	1.024	0.867
1890	1.084	1.071	0.979	1.465	0.915	0.915	0.858	0.972	0.812	0.658	0.864	0.807	0.827	0.812	1.191	1.053	0.780	0.749	1.004	0.809	1.000	0.965	0.959	1.002	0.871	0.971	0.786	0.746	0.764
1891	1.112	1.097	0.990	1.309	0.982	0.975	1.023	0.939	0.641	0.781	0.885	0.882	0.695	0.700	0.888	0.650	0.556	0.641	0.613	0.380	0.636	0.842	0.747	0.798	0.858	0.792	1.165	0.894	1.006
1892	1.230	0.983	0.704	1.086	0.906	0.780	0.928	0.827	0.565	0.786	0.812	0.794	0.668	0.656	0.841	0.677	0.644	0.649	0.673	0.467	0.875	1.012	0.862	1.022	0.990	0.968	1.025	0.966	0.928
1893	1.031	0.810	0.846	1.184	0.986	0.844	0.876	0.948	0.850	1.020	0.662	0.792	0.749	0.801	0.879	0.955	0.758	0.737	0.902	0.679	1.319	1.110	1.144	1.255	1.114	1.031	0.894	0.826	1.163
1894	1.087	0.985	0.927	1.281	0.874	0.771	1.045	0.952	0.612	0.717	0.800	0.907	0.699	0.776	0.916	0.867	0.695	0.705	0.889	0.531	1.358	1.075	1.270	1.260	1.103	1.097	0.842	0.795	0.887
1895	1.311	1.172	1.107	1.101	0.931	1.014	0.782	0.529	0.745	0.975	0.621	0.522	0.657	0.659	0.808	0.758	0.968	0.779	0.742	0.384	0.515	0.736	0.879	0.724	0.768	0.624	0.731	0.661	1.141
1896	1.535	1.334	1.195	1.309	1.173	0.994	0.966	0.799	0.998	0.797	0.789	0.831	1.052	0.958	0.865	0.942	1.375	0.992	1.400	1.000	1.573	1.046	1.566	1.396	1.285	1.136	1.318	1.103	1.261
1897	1.322	1.266	1.049	1.125	1.030	0.908	1.020	0.581	0.792	0.900	0.579	0.482	0.400	0.379	0.616	0.532	0.651	0.553	0.551	0.150	0.775	0.797	1.001	1.082	0.743	0.428	0.873	0.677	1.255
1898	1.410	1.298	1.057	1.193	1.100	0.937	0.977	0.597	0.692	0.586	0.740	0.652	0.751	0.705	0.842	0.844	0.886	0.764	0.838	0.481	0.822	0.787	0.965	0.910	0.784	0.565	0.878	0.875	0.886
1899	1.481	1.391	1.135	1.234	1.211	1.152	1.080	1.013	0.960	1.118	0.938	0.892	1.187	1.137	1.102	1.321	1.124	0.966	1.289	1.114	1.511	0.984	1.346	1.287	1.148	0.987	0.806	0.759	0.942
1900	1.131	1.029	0.977	1.147	0.856	0.940	0.960	0.759	1.325	1.305	0.847	1.003	0.980	0.992	0.958	1.165	1.071	0.999	1.544	1.362	0.807	0.850	0.854	1.019	0.766	0.679	0.774	0.727	1.196
1901	1.062	1.123	0.971	1.138	0.659	0.903	0.901	0.751	0.887	0.869	0.774	0.949	0.940	1.033	0.856	1.175	0.968	0.861	1.253	1.203	1.070	0.993	0.983	1.176	0.900	0.900	0.897	0.984	1.004
1902	1.517	1.295	1.180	1.340	1.161	1.165	1.281	1.229	1.048	1.061	1.072	1.301	1.160	1.277	0.775	0.948	1.137	1.154	1.335	1.283	1.239	1.130	1.094	1.220	1.006	0.950	0.707	0.887	1.044
1903	1.176	1.019	1.058	1.323	0.750	1.080	0.896	0.817	0.677	0.929	0.670	1.139	0.531	1.161	0.693	1.059	0.540	0.859	0.949	1.117	0.563	1.010	0.791	1.026	0.720	0.883	0.983	1.092	0.779

YEAR	POLDF	POLWF	FLEDF	FLEWF	LAJDF	LAJWF	ALADF	ALAWF	BARDF	BARWF	EFKDF	EFKWF	LEFDF	LEFWF	LOGDF	LOGWF	WVADF	WVAWF	PEHDF	PEHWF	FWNDF	FWNWF	REDDF	REDWF	BONDF	BONWF	SRRDF	SRRWF	RTCDF
1904	1.523	1.157	1.349	1.453	1.329	1.231	0.972	1.328	0.989	1.067	0.893	1.126	1.127	1.241	0.825	1.229	1.309	1.294	1.374	1.366	1.257	0.963	1.175	1.204	0.900	1.152	0.666	0.914	0.803
1905	1.230	0.878	0.864	0.919	0.743	0.902	0.742	0.587	0.888	1.002	0.913	1.141	0.886	1.144	0.847	1.013	0.872	0.994	0.996	1.188	1.214	1.193	1.205	1.305	1.147	1.195	1.492	1.431	1.245
1906	1.564	1.195	1.047	1.042	1.024	1.105	0.746	0.734	0.883	1.098	1.080	1.333	1.321	1.495	1.043	1.280	1.201	1.299	1.272	1.471	1.176	1.138	1.232	1.259	1.135	1.093	1.154	1.146	1.098
1907	1.390	0.801	1.117	0.929	0.973	0.909	0.934	0.704	0.683	0.724	0.995	1.111	1.199	1.043	1.032	0.958	1.066	1.023	1.049	1.112	0.885	1.002	0.978	1.029	1.059	1.055	1.017	0.960	1.427
1908	0.955	0.493	1.112	0.865	0.555	0.895	0.581	0.646	0.870	0.950	0.919	1.053	1.052	0.780	0.805	0.890	1.341	0.957	0.968	1.051	1.097	1.104	1.136	1.195	1.004	1.087	1.085	1.104	1.140
1909	1.256	0.979	0.995	1.044	0.867	1.038	0.954	0.968	0.833	0.801	1.179	1.271	1.021	1.050	0.994	1.093	1.086	1.067	1.112	1.270	1.404	1.184	1.342	1.381	1.229	1.268	1.112	0.980	1.134
1910	1.491	0.974	1.119	1.047	0.969	0.935	1.147	1.068	0.991	0.937	1.167	1.059	0.826	0.871	1.006	1.051	1.031	1.057	1.449	1.451	1.411	1.202	1.074	1.191	1.218	1.189	1.257	0.999	1.098
1911	1.073	0.862	1.094	0.992	0.731	0.778	0.886	0.868	0.716	0.652	0.803	0.847	0.766	0.732	0.820	0.883	0.768	0.685	1.010	1.040	0.824	1.019	0.799	1.016	0.978	0.921	0.829	0.860	0.927
1912	1.120	1.013	0.866	0.925	0.753	0.775	0.952	1.074	0.884	0.930	1.098	1.060	1.141	1.183	0.940	0.970	1.378	1.149	0.934	1.062	0.706	1.149	0.840	0.946	1.081	0.906	1.251	0.956	1.128
1913	1.285	1.276	1.045	1.233	0.987	1.086	1.365	1.463	0.923	0.995	0.950	1.089	0.745	0.880	0.947	1.060	1.057	1.070	1.183	1.355	1.360	1.302	1.172	1.296	1.283	1.248	1.132	1.089	1.003
1914	1.254	1.191	1.145	1.272	0.956	1.034	1.305	1.318	0.909	0.703	0.735	1.015	0.760	0.732	0.898	0.986	1.131	0.768	0.606	0.850	0.417	0.960	0.631	0.883	0.681	0.696	0.983	1.006	0.703
1915	1.289	1.037	0.939	1.054	0.868	0.869	1.239	1.154	0.760	0.706	0.924	1.136	0.952	0.899	0.817	1.016	1.247	0.955	0.472	0.774	0.517	0.945	0.619	0.782	0.718	0.632	1.294	1.038	0.721
1916	1.310	1.155	0.808	0.928	0.858	0.964	1.235	1.105	0.540	0.653	0.977	1.137	0.782	0.932	0.618	0.822	1.168	1.046	0.264	0.365	1.295	1.255	1.168	1.247	1.085	1.235	1.451	1.260	1.058
1917	1.728	1.505	1.133	1.298	1.367	1.250	1.595	1.587	0.845	0.931	1.038	1.372	1.161	1.316	0.729	0.734	1.370	1.084	0.525	0.273	0.716	1.049	0.877	0.945	0.668	0.713	0.825	0.750	0.756
1918	1.014	1.144	0.878	1.040	0.791	0.949	0.848	0.954	0.606	0.751	0.799	0.918	0.570	0.721	0.572	0.625	0.928	0.883	0.499	0.348	0.888	1.005	1.061	1.206	0.816	0.976	0.414	0.610	1.001
1919	0.995	1.133	1.097	1.143	0.838	1.042	1.084	1.074	0.751	1.057	0.626	0.799	0.688	0.825	0.493	0.475	1.241	0.955	0.407	0.070	0.674	1.093	0.943	1.001	0.632	0.685	0.778	0.780	0.740
1920	1.229	1.191	1.115	1.271	1.062	1.117	1.230	1.380	0.882	0.916	0.640	0.655	0.912	0.875	0.458	0.279	1.576	1.177	0.456	[illegible]	1.043	1.205	1.020	1.233	0.708	0.882	1.354	1.388	0.905
1921	0.530	0.691	0.748	0.859	0.880	0.814	0.748	0.823	0.949	1.059	0.727	0.885	0.948	1.024	0.699	0.614	1.275	1.209	0.645	0.320	0.769	1.152	1.049	1.208	0.613	0.692	1.232	1.228	0.812
1922	1.364	1.266	1.286	1.679	1.398	1.211	1.164	1.322	1.122	1.174	0.893	1.226	0.985	1.062	1.059	1.064	1.304	1.223	1.328	1.047	1.175	1.067	0.937	1.088	1.051	1.155	0.843	0.803	0.902
1923	1.015	1.214	0.835	1.329	1.092	1.322	1.114	1.301	1.142	1.377	0.748	1.066	0.725	0.890	0.935	1.019	1.013	1.125	1.166	1.053	0.951	0.940	0.809	0.933	0.811	0.975	0.703	0.765	0.830
1924	1.157	1.263	1.059	1.646	1.125	1.173	1.290	1.458	0.909	1.020	0.735	0.894	0.874	0.928	0.943	1.095	1.183	1.191	0.960	0.853	1.175	1.170	1.052	1.217	0.962	1.199	1.645	1.487	1.009
1925	1.213	1.317	1.224	1.756	1.296	1.412	0.885	1.210	1.344	1.514	1.019	1.120	1.025	1.107	1.121	1.370	1.156	1.194	1.322	1.323	1.309	1.074	1.123	1.071	1.104	1.201	1.363	1.249	0.950
1926	0.881	1.035	0.875	1.409	1.052	1.134	0.944	0.998	1.200	1.157	0.883	0.815	1.012	1.014	1.096	1.220	1.269	1.173	1.074	1.112	1.040	1.103	1.056	1.067	0.818	0.981	1.159	1.300	1.122
1927	0.842	0.929	0.975	1.511	1.066	0.972	0.710	0.880	1.000	1.078	1.159	0.953	1.058	1.096	1.172	1.076	1.132	1.239	1.532	1.307	1.160	1.037	1.127	1.092	0.985	1.041	1.242	1.394	1.041
1928	0.976	0.955	1.182	1.649	1.190	0.997	1.158	1.263	1.108	1.151	1.079	1.055	0.969	1.026	0.993	1.106	1.237	1.237	1.561	1.390	1.255	1.053	1.024	0.991	1.066	1.006	1.165	1.104	1.133
1929	0.763	0.819	1.038	1.386	0.891	0.997	0.832	1.040	0.888	0.886	1.029	0.986	0.824	0.897	0.974	1.078	0.890	1.087	1.326	1.199	1.146	1.083	1.026	1.010	0.983	1.065	1.046	1.093	0.889
1930	1.059	0.942	1.052	1.354	1.108	1.007	0.951	1.130	0.910	0.914	0.890	0.988	0.988	1.049	1.060	1.233	1.163	1.411	1.233	1.142	1.208	1.096	1.163	1.081	1.225	1.181	0.995	1.023	1.180
1931	1.271	1.021	1.015	1.312	1.255	1.205	1.241	1.394	0.966	1.033	1.119	1.144	0.872	0.874	1.090	1.188	1.220	1.283	1.421	1.283	1.243	0.991	1.187	0.983	1.286	1.047	0.928	0.836	1.057
1932	0.902	0.748	0.906	1.211	1.010	0.941	0.733	1.015	1.070	1.084	1.332	1.300	1.578	1.312	1.345	1.398	1.827	1.832	1.418	1.356	1.287	1.090	1.323	1.109	1.211	1.124	1.626	1.351	1.234
1933	0.999	0.809	0.952	1.104	1.303	1.000	0.889	1.035	1.403	1.332	1.443	1.424	1.342	1.131	1.390	1.468	1.971	1.725	1.730	1.595	1.005	0.843	1.162	0.886	1.310	0.994	0.593	0.588	1.265
1934	1.351	1.218	1.176	1.392	1.708	1.314	0.988	1.238	1.250	1.159	1.266	1.178	0.957	0.921	1.071	1.202	1.418	1.331	1.594	1.596	1.333	1.046	1.008	0.822	1.322	1.115	1.338	1.151	1.103
1935	0.876	0.773	0.908	0.995	0.936	0.903	0.700	0.847	1.143	1.040	1.139	1.028	1.154	0.915	1.029	1.189	1.450	1.449	1.242	1.397	1.057	1.105	0.945	0.890	1.311	1.058	1.172	1.072	1.228
1936	1.179	0.984	1.006	1.189	1.218	1.011	1.136	1.284	1.285	1.199	1.144	1.119	0.959	0.897	1.017	1.203	1.261	1.226	1.117	1.268	1.274	1.172	1.069	0.912	1.380	1.168	1.167	1.057	1.295
1937	1.034	0.861	0.875	1.132	0.988	1.023	0.967	1.065	1.192	0.979	1.153	0.953	0.960	0.954	0.894	0.884	1.032	1.090	0.817	1.037	0.714	1.124	0.762	0.689	1.384	0.958	1.070	1.139	1.072
1938	0.966	0.945	0.694	1.031	0.897	0.942	0.774	0.712	1.022	1.006	1.295	1.183	0.916	0.977	1.023	1.029	0.866	0.880	1.175	1.284	0.900	1.184	0.919	0.841	1.343	1.117	1.106	1.042	1.054
1939	1.324	1.375	0.752	1.066	1.123	1.143	0.902	0.959	0.903	0.846	1.217	1.314	1.029	1.164	1.011	1.068	1.028	1.189	1.311	1.616	1.421	1.177	1.188	1.084	1.463	1.744	1.426	1.363	1.064
1940	1.026	1.184	0.668	0.956	0.917	1.054	0.738	0.538	1.019	0.868	0.907	1.198	0.627	0.824	0.963	0.903	0.894	0.941	1.011	1.367	0.676	0.784	0.801	0.695	1.075	1.559	0.616	0.691	1.248
1941	0.532	0.921	0.463	0.691	0.481	0.750	0.368	[illegible]	0.913	0.804	0.958	1.209	1.110	1.360	0.798	0.547	1.269	1.245	0.941	1.207	0.539	1.138	0.990	0.916	1.061	1.502	1.104	1.204	1.215

YEAR	POLDF	POLWF	FLEDF	FLEWF	LAJDF	LAJWF	ALADF	ALAWF	BARDF	BARWF	EFKDF	EFKWF	LEFDF	LEFWF	LOGDF	LOGWF	WVADF	WVAWF	PEHDF	PEHWF	FWNDF	FWNWF	REDDF	REDWF	BONDF	BONWF	SRRDF	SRRWF	RTCDF
1942	0.753	0.897	0.515	0.724	0.802	0.856	0.836	0.400	0.654	0.601	0.927	1.101	0.923	1.319	0.687	0.339	1.027	1.107	0.878	1.017	1.094	1.205	1.253	1.206	1.469	1.736	1.509	1.441	1.379
1943	0.570	0.762	0.489	0.864	0.582	0.898	0.694	0.637	0.581	0.540	0.830	0.949	0.597	0.805	0.748	0.514	0.780	0.835	1.083	1.053	1.049	0.863	0.952	0.888	1.410	1.857	0.756	0.958	0.885
1944	0.998	1.092	0.789	1.278	1.053	1.196	1.229	1.101	0.623	0.491	0.968	0.809	0.670	0.555	0.915	0.525	0.957	0.769	1.004	0.822	1.099	1.310	1.123	1.152	1.458	1.606	1.646	1.408	1.357
1945	0.854	1.025	0.677	1.049	1.182	1.151	1.063	0.908	0.614	0.478	0.906	0.675	0.577	0.528	0.899	0.493	0.867	0.745	0.806	0.723	1.151	1.285	1.120	1.187	1.365	1.627	1.541	1.425	1.143
1946	0.935	0.881	0.771	1.085	1.239	1.128	1.046	0.868	1.227	1.145	0.883	0.898	0.771	0.831	0.913	0.958	1.139	1.063	1.125	1.107	1.204	0.883	1.022	0.894	1.236	1.499	0.780	0.884	0.910
1947	0.871	0.765	0.945	1.077	1.113	1.053	1.156	0.853	1.177	0.839	1.062	0.849	0.859	0.762	0.861	0.669	0.938	0.847	0.902	0.765	0.844	1.175	0.892	0.771	1.147	0.925	1.148	0.953	1.315
1948	0.877	0.877	0.896	0.910	1.271	1.208	1.076	0.608	1.035	0.954	0.854	0.678	0.820	0.711	1.016	0.817	1.194	1.015	0.805	0.558	0.974	1.134	1.010	0.941	1.345	1.235	1.110	1.071	1.404
1949	0.828	0.921	1.049	1.077	1.106	1.180	1.007	0.560	0.849	0.784	0.758	0.426	0.599	0.529	0.874	0.609	0.705	0.600	0.547	0.155	0.924	1.249	0.992	0.850	1.581	1.208	1.292	1.223	1.130
1950	0.937	0.949	1.064	1.094	1.144	1.092	0.710	0.714	0.981	1.041	0.837	0.784	0.743	0.790	1.110	1.103	1.014	0.919	1.401	0.916	1.073	1.080	1.028	0.895	1.748	1.437	0.924	1.236	1.180
1951	1.104	1.031	1.107	1.096	1.243	1.058	0.931	0.965	1.245	1.272	0.811	0.898	0.920	0.974	0.939	1.084	1.185	1.086	1.201	0.982	1.107	0.890	0.964	0.869	1.325	1.152	1.299	1.140	1.248
1952	0.855	0.790	0.845	0.861	0.875	0.845	0.887	0.561	1.070	0.956	0.858	0.552	0.924	0.823	0.935	0.903	1.097	1.039	0.837	0.531	1.092	0.956	0.922	0.881	1.196	1.168	1.128	1.024	1.093
1953	0.867	0.970	1.039	1.094	0.937	0.851	1.050	0.911	1.279	1.383	0.964	0.915	1.014	1.059	1.007	1.140	1.200	1.214	1.302	1.073	0.942	1.016	0.802	0.874	1.265	1.028	1.120	1.118	1.169
1954	0.466	0.602	1.021	1.097	0.508	0.567	0.567	0.670	1.023	1.085	0.744	0.634	0.999	1.059	0.903	0.991	1.063	1.086	0.991	0.749	0.935	1.107	0.818	0.989	1.257	1.442	0.957	1.236	1.035
1955	1.133	1.110	1.323	1.257	1.135	1.097	1.209	1.130	1.310	1.301	0.954	0.919	1.033	1.130	0.934	0.992	1.199	1.151	1.385	1.083	0.976	1.207	0.937	1.004	1.488	1.328	0.983	1.271	1.164
1956	1.187	1.116	1.303	1.347	1.156	0.935	0.995	1.165	1.204	1.149	0.919	0.837	0.881	0.951	0.759	0.843	1.044	0.976	1.048	0.907	1.216	0.900	1.080	1.014	1.618	1.688	0.740	0.846	1.066
1957	1.007	1.071	1.023	0.892	0.982	0.996	1.018	0.918	1.036	1.102	0.688	0.635	0.868	0.859	0.788	0.859	0.902	0.895	0.818	0.703	0.758	1.158	0.774	1.006	1.108	1.195	1.154	1.386	1.171
1958	1.311	1.235	1.093	1.135	1.146	1.087	1.335	1.043	1.017	1.103	0.903	0.802	1.044	1.157	1.005	1.060	1.076	1.120	0.961	0.806	1.182	1.370	1.152	1.364	1.522	1.453	1.535	1.585	1.332
1959	1.099	1.087	1.115	0.968	1.076	1.064	1.342	0.912	0.977	1.222	1.127	0.935	1.188	1.363	1.084	1.093	0.933	0.960	1.205	0.884	0.753	0.958	0.712	0.864	1.355	1.399	0.913	1.292	0.978
1960	1.078	0.994	0.838	0.705	0.891	0.875	1.356	0.773	0.891	1.131	1.123	0.932	1.271	1.376	1.141	1.143	0.783	0.699	1.100	0.728	0.965	1.240	0.951	1.086	1.792	1.554	1.220	1.632	1.054
1961	1.305	1.057	0.881	0.644	1.067	1.017	1.300	0.654	0.747	1.095	1.232	1.099	1.293	1.329	1.182	1.010	0.720	0.819	1.068	0.583	1.242	1.324	1.277	1.504	1.673	1.585	0.978	1.331	1.136
1962	1.389	1.086	1.041	0.800	1.183	1.067	1.388	0.732	0.979	1.131	1.221	1.201	1.041	1.173	1.137	1.114	0.897	0.932	1.089	0.741	1.646	1.402	1.642	1.923	1.684	1.710	1.231	1.431	1.285
1963	1.063	0.953	1.129	0.804	1.062	0.902	1.186	0.873	1.038	1.276	1.265	1.383	1.053	1.167	1.165	1.077	1.007	1.031	1.387	1.144	1.120	0.887	0.974	0.971	1.382	1.465	0.924	1.104	0.859
1964	1.158	1.083	1.483	1.173	1.220	0.996	1.274	1.133	1.269	1.230	0.944	1.162	1.017	0.887	0.893	0.884	1.050	0.869	1.116	0.970	1.112	0.883	1.054	1.046	1.337	1.347	0.627	0.771	1.244
1965	0.936	0.916	1.431	0.778	0.983	0.938	1.222	0.699	1.244	1.371	0.983	0.998	1.127	0.945	1.045	1.124	1.253	1.039	0.949	0.851	1.126	1.245	1.188	1.252	1.706	1.107	1.379	1.420	1.420
1966	1.024	1.072	1.759	1.177	1.076	0.991	1.516	1.112	1.136	1.425	1.370	1.230	1.216	1.078	1.396	1.373	1.052	0.994	1.177	1.255	1.184	1.284	1.207	1.158	2.252	1.485	0.631	1.092	1.219
1967	1.042	1.140	1.745	1.234	1.185	1.070	0.882	1.101	1.227	1.486	1.357	1.501	1.030	0.980	1.014	1.236	1.090	1.038	1.431	1.778	1.178	1.082	1.335	1.492	1.743	1.247	0.397	0.775	0.837
1968	1.253	1.296	1.611	1.269	1.303	1.152	1.458	1.334	1.451	1.494	1.162	0.992	1.090	0.934	1.204	1.302	0.857	0.951	1.086	1.375	1.286	1.128	1.485	1.628	1.684	1.242	1.307	1.251	1.379
1969	0.829	1.204	1.530	0.990	0.991	1.111	1.110	1.091	1.349	1.458	1.233	1.039	1.230	1.116	1.184	1.375	1.035	1.095	1.031	1.374	0.798	0.943	1.088	1.086	1.119	0.646	0.691	0.771	1.265
1970	1.326	1.573	1.924	1.378	1.377	1.356	1.424	1.621	1.401	1.487	1.163	1.032	1.437	1.289	1.153	1.294	0.841	0.897	0.899	1.204	0.801	0.958	0.979	1.036	1.009	0.617	0.572	0.797	0.959
1971	1.421	1.496	1.899	1.547	1.530	1.290	1.252	1.723	1.141	1.284	1.545	1.642	1.097	1.153	1.137	1.357	0.945	0.946	1.410	1.896	1.340	0.866	1.123	1.090	1.271	1.215	0.763	0.969	0.873
1972	1.132	1.273	1.799	1.170	1.079	0.914	1.638	1.581	0.998	1.081	1.094	1.051	1.340	1.201	1.057	1.254	0.810	1.008	0.849	1.475	1.615	1.154	1.369	1.250	1.585	1.210	1.583	1.864	1.313
1973	1.090	1.236	1.455	1.263	1.127	1.107	1.288	1.519	1.513	1.698	1.132	1.189	1.610	1.294	1.217	1.453	1.226	1.333	1.035	1.435	1.200	0.789	1.102	1.223	0.992	0.747	1.133	1.450	1.205
1974	1.115	1.322	1.519	1.389	1.196	1.069	1.167	1.492	1.305	1.424	1.313	1.413	1.212	1.092	1.359	1.444	1.012	1.097	1.401	1.626	1.353	0.941	1.187	1.254	1.314	1.064	0.811	1.036	1.199
1975	1.165	1.431	1.858	1.576	1.324	1.284	1.426	1.625	1.142	1.289	0.979	0.983	1.147	1.078	1.131	1.197	0.664	1.021	0.708	1.232	1.259	0.947	1.432	1.549	1.301	0.970	1.229	1.553	0.852
1976	0.913	1.250	1.289	1.204	1.111	1.059	1.062	1.344	1.074	1.095	1.213	1.325	0.999	1.064	1.420	1.575	0.816	0.955	1.084	1.839	1.721	1.321	1.475	1.778	1.367	1.299	1.280	1.526	1.114
1977	0.882	1.110	1.109	1.108	0.957	0.993	1.161	1.347	1.309	1.276	1.371	1.540	1.058	1.081	1.333	1.490	1.003	1.039	1.265	1.893	1.172	0.741	0.852	1.008	1.193	0.932	0.612	1.122	0.745
1978	0.998	1.143	1.195	1.245	1.112	1.113	0.996	1.281	1.234	1.221	1.150	1.125	1.279	1.139	1.187	1.362	0.890	1.154	0.675	1.513	1.051	0.636	1.039	1.080	1.221	0.907	1.252	1.373	1.112
1979	0.907	1.107	1.071	0.991	1.065	1.090	1.003	1.221	1.442	1.488	1.353	1.341	1.531	1.413	1.485	1.684	1.132	1.380	0.811	1.682	0.855	0.711	0.924	1.042	1.074	0.724	0.869	1.390	0.867

YEAR	POLDF	POLWF	FLEDF	FLEWF	LAJDF	LAJWF	ALADF	ALAWF	BARDF	BARWF	EFKDF	EFKWF	LEFDF	LEFWF	LOGDF	LOGWF	WVADF	WVAWF	PEHDF	PEHWF	FWNDF	FWNWF	REDDF	REDWF	BONDF	BONWF	SRRDF	SRRWF	RTCDF
1980	0.947	1.219	0.855	0.935	1.037	1.020	0.976	1.278	1.299	1.121	1.165	1.318	1.400	1.560	1.275	1.559	0.935	1.201	0.766	1.682	1.149	0.777	1.094	1.182	1.101	0.903	1.177	1.538	1.078
1981	1.084	1.451	1.171	1.212	1.250	1.259	1.009	1.533	0.968	0.811	0.900	1.105	1.047	1.403	1.347	1.516	0.477	0.664	0.762	1.475	0.513	0.260	0.649	0.533	0.728	0.548	0.356	0.651	0.699
1982	1.081	1.619	1.266	1.416	1.482	1.466	1.059	1.527	0.979	0.565	0.979	1.031	1.162	1.334	1.265	1.481	0.663	0.806	0.585	1.074	0.964	0.618	0.741	0.640	0.833	0.759	0.475	0.846	0.876
1983	1.067	1.628	1.161	1.262	1.611	1.641	0.991	1.308	0.969	0.344	1.099	1.014	1.479	1.453	1.009	1.200	1.066	1.255	0.354	0.664	0.209	0.000	0.308	******	0.059	0.000	0.462	0.801	0.770
1984	1.207	1.606	1.063	1.301	1.283	1.442	1.030	1.297	1.411	0.245	1.010	0.786	0.896	0.958	1.055	0.760	0.657	0.700	0.492	0.622	1.903	0.558	1.369	0.831	0.677	0.309	1.042	1.186	1.047
1985	0.886	1.435	0.932	1.055	1.233	1.302	1.015	1.046	1.027	0.000	0.742	0.310	0.883	0.508	1.002	0.552	0.856	0.882	0.150	0.000	0.800	0.000	0.822	0.054	0.001	0.000	0.298	0.504	0.620
1986	0.432	1.144	0.510	0.308	0.731	1.047	0.734	0.513	1.875	0.006	0.908	0.259	1.043	0.611	1.218	0.880	0.475	0.403	0.167	0.000	1.658	0.000	0.922	0.000	0.000	0.000	0.000	0.240	0.000
1987											0.921	0.639	1.046	0.944							4.268	0.950	1.769	0.877					0.752
1988																													0.085
1989																													1.025

Long-Term Patterns

of Western Spruce Budworm Outbreaks

in

Northern New Mexico

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Abstract

Long tree-ring chronologies from 24 mixed-conifer stands in Northern New Mexico were used to reconstruct the history of western spruce budworm (*Choristoneura occidentalis* Freeman) outbreaks. Eight major outbreak episodes were identified from 1690 to 1989. Frequency and duration of outbreaks have not obviously changed during this period. However, an unusually long period of reduced budworm activity occurred from about 1925 to 1945, and the most recent episode was the most severe. An exceptionally long outbreak chronology was reconstructed for one stand (1210-1989). This chronology reveals that episodic outbreaks can be sustained within a forest stand for at least eight centuries. A comparison of outbreak history with an independent tree-ring reconstruction of annual precipitation shows no clear relation between this climatic parameter and budworm outbreaks.

Introduction

During the 1970s and 80s a widespread and severe outbreak of the western spruce budworm defoliated and killed tens of thousands of conifers in the Central and Southern Rockies. Given the high economic and scenic value of the affected forests, it is not surprising that this outbreak caused great concern. A public debate ensued over the proper response to this phenomenon, particularly with regard to the use of aerially applied insecticides (USDA Forest Service, 1986). Although forest managers and ecologists recognized the budworm as an endemic pest in this region, knowledge of the long-term frequency, intensity and extent of outbreaks was lacking. Was the recent outbreak unusual in the long-term context of forest history? Have management practices or other human-caused changes in the landscape led to changes in the budworm-forest dynamic? Historical reconstructions of budworm outbreak history are a first step in addressing such questions. In addition to providing a long-term perspective for management decisions, these histories offer temporal and spatial ecological data that may be used to investigate interactions of site characteristics, climate change, and disturbance.

Unlike the eastern spruce budworm (*Choristoneura fumiferana*) in Canada, the western species has generally not resulted in high levels of host tree mortality in New Mexican forests, at least during the period of forestry records (about post-1910) (Perry 1925, Lessard 1975). Douglas-firs (*Pseudotsuga menziesii*) and true firs (*Abies spps.*) are usually the main hosts. Trees are defoliated for periods of a few years to more than a decade, and then budworms become rare in affected stands for years to decades. While some success has been achieved in limiting outbreak extent and intensity in New Mexico via insecticide spraying (Telfer *et al.* 1983, 1984), the effects of this action on long-term budworm dynamics is unknown. In the recent past, most trees in defoliated stands survived episodic outbreaks, whether they were sprayed or not. Thus, unusually high levels of mortality during the recent outbreak suggests that a change in the forest/budworm dynamic has taken place.

Retrospective studies using tree-ring records as indicators of past outbreaks identified possible changes in western spruce budworm dynamics in the Northern Rockies (McCune 1983, Anderson *et al.* 1987). Blais' tree-ring studies (1962, 1965, 1983, 1985) also documented temporal changes in budworm (*C. fumiferana*) outbreaks in eastern Canada. Increased frequency, duration or intensity of outbreaks during the twentieth century was attributed to human-caused changes in forest stand structure and composition. It was argued that some combination of fire suppression, logging practices, and insecticide spraying led to more budworm susceptible and vulnerable stands (Blais 1983, Carlson *et al.* 1983, Fellin *et al.* 1983, Schmidt 1987, Anderson *et al.* 1987).

In a dendroecology study of ten mixed-conifer stands in Colorado and New Mexico we found that budworm outbreaks were not measurably more frequent in the twentieth century relative to the nineteenth and eighteenth centuries (Swetnam and Lynch 1989). However, temporal patterns showed increased synchrony of outbreaks in widely scattered forests of the Southern Rockies. The intensity of the most recent outbreak (1970s and 1980s) was also greater than previous outbreaks. We also hypothesized that greater extent and intensity of budworm outbreaks in this century were related to human-caused forest changes. In particular, we argued that preferential harvesting of ponderosa pine during the Anglo-American settlement era (about 1850 to 1910), large fires in the late 1800s, and fire suppression after 1900 led to twentieth century forests with higher proportions and densities of budworm host trees than existed in pre-settlement forests. Modern forests provide spatially continuous and suitable food substrate for the budworm which promotes extensive and severe outbreaks.

A limitation of our earlier study was that relatively few stands were sampled over a very large region. Here we describe a larger data set of budworm outbreak chronologies from 24 stands concentrated in Northern New Mexico. Utilizing this expanded data set we examine patterns of long-term changes in budworm outbreak regimes. An exceptionally long chronology from one of the stands is also described. Utility of these records for assessing interactions of disturbances, climate change, forest and insect population dynamics are discussed.

Study Areas

Study sites were clustered in three areas in northern New Mexico, U.S.A. (Fig. 1 and Table 1) within the boundaries of the Carson and Santa Fe National Forests. The three areas correspond to ranger district names:

Jemez: These stands are on the western side of the Rio Grande in the Jemez Mountains. Stands are located along the upper Jemez River, Rio Vallecitos, and Rito de los Frijoles watersheds. Stand 17 is located on the Tres Ritos ranger district to the north of the Jemez Mountains. We grouped this stand with the Jemez data because it is also an the west side of the Rio Grande and because we noticed similarities in outbreak history.

Questa: These stands are on the east side of the Rio Grande in the Sangre de Cristo Mountains north of Taos. The stands are located along the west flowing Cabresto Creek and Red River watersheds.

Camino Real: These stands are on the east side of the Rio Grande in the Sangre de Cristo Mountains south and east of Taos. The stands are located along the west flowing Rio Pueblo and Rio de Taos watersheds. Stand 15 is in the Coyote Creek watershed on the eastern slope of the Sangre de Cristos.

Elevations of sampled stands are between 2410 and 3050 m (Table 1). At Los Alamos (2210 m elevation) the average annual precipitation for the period 1911-1988 was 43 cm, of which 18 cm (40%) fell during a three to six week period in July and August. The remaining moisture was fairly evenly distributed throughout the year (Bowen 1989). The coldest months, December, January, and February, were also the driest. Winters were temperate, with mean January temperatures of -1.7 °C. Summers were generally arid and hot until late July when afternoon thundershowers were typical.

Topographic position varied from steep slopes to flat ridge tops. Aspects in most stands were generally north and north-east, but were south for stands 13, 18, 21, and 23. Stand 19 had an east aspect.

Sampled stands were mixed-conifer composed of varying proportions of budworm host

species Douglas-fir (*Pseudotsuga menziesii* var. *glauca* [Mirb.] Franco., white fir *Abies concolor* [Gord. and Glend.] Lindl.), subalpine fir (*Abies lasiocarpa* [Hook.] Nutt.), and Engelmann spruce (*Picea engelmannii* Parry). Non-host species present in the sampled stands were ponderosa pine (*Pinus ponderosa* Laws.), and trembling aspen (*Populus tremuloides* Michx.). Species found less frequently were limber pine (*P. flexilis* James), bristlecone pine (*P. aristata* Engelm.), Colorado blue spruce (*Picea pungens* Engelm.), Rocky Mountain maple (*Acer glabrum* Torr.), and Gambel oak (*Quercus gambelii* Nutt.).

Methods

Field Methods: Twenty-four stands were selected containing both Douglas-fir, and white fir. Old growth stands with minimal or no history of logging were preferred. This strategy enabled us compare the response of the two main host species and also to maximize the length of reconstructed budworm history. In one case (stand 13, Rito Claro) too few white fir were present to develop a tree-ring chronology (minimum of about 10 trees), but this stand contained the oldest sampled Douglas-fir trees. In most watersheds it was difficult to find old growth stands that had not been partially cut, and even the virgin stands we sampled were usually surrounded by forest lands with a long history of logging. Four stands (17, 22, 23, and 24) were sampled in an earlier study (Swetnam and Lynch 1989). An additional strategy was to sample a variety of mixed-conifer habitat types (sensu Moir and Ludwig, 1979, DeVelice *et al.* 1986) in order to test differential vulnerability of stands classified by this scheme. Results of this analyses will be reported elsewhere.

A 5 ha area was sampled within each stand. Three evenly spaced transects were located parallel to the topographic contour. Three to 5 evenly spaced sample points were located on each transect, for a total of 9 to 15 points per stand. Stocking (m^2/ha) and density (stems/ha) were estimated by species and diameter-class at each point using a prism or relascope and variable plot techniques (Husch *et al.* 1982). Spiked (dead) and crooked tops were noted when present, as they can be indicative of past insect damage.

Increment cores were taken at each sample point from the nearest Douglas-fir and white

fir greater than 20.3 cm (8 in.) dbh. White fir was not present at all points. Cores were taken from at least two radii per tree, parallel with the contour of the slope. An additional ten or more of the oldest appearing host trees (approximately five of each species) within the stand were cored in order to obtain the longest record possible.

Increment cores were also taken from non-host trees (ponderosa pine, limber pine, or piñon (*Pinus edulis* Engelm.)) in nearby stands. These stands were located at similar or slightly lower elevations (2450 to 2750m), and were selected because they were monospecific (or nearly so).

Laboratory Analyses. Dendrochronology procedures and techniques for analyzing radial growth in budworm-defoliated trees were described and illustrated by Swetnam *et al.* (1985) and Swetnam and Lynch (1989). Host and non-host increment core samples were crossdated, ring widths were measured on a sliding-stage micrometer, and then transformed to growth indices by fitting curves to the series and dividing the ring widths by the values of the fitted curves (Fritts 1976). Depending on the shape of the age-related growth trend, a negative exponential, straight line of negative slope, or cubic spline was fit to each core series (Graybill 1979, Cook and Peters 1981, Cook and Holmes 1986. Only relatively "stiff" cubic splines were used (50% frequency response splines with minimum 100 year lengths [see Cook and Peters 1981]). Thus, most low frequency variations in the ring-width series were preserved. Tree and stand chronologies were derived by simple averages of the core indices.

Host and non-host tree-ring series were graphically and statistically compared to determine if the different species responded similarly to climate but differently during periods of known budworm defoliation. The statistical comparisons consisted of correlation analysis of host and non-host chronologies for entire common periods and for shorter "moving" periods (Swetnam 1987a). In earlier work a similar climatic response between host and non-host tree-ring chronologies was found using principal components analysis (Swetnam 1987b).

Graphical comparisons included overlay plotting of host and non-host tree-ring series. Pronounced and persistent differences between host and non-host chronologies were taken as

preliminary evidence of past outbreaks. Procedures developed by Nash *et al.* (1975) were used to correct the host tree-ring series for climatic and other non-budworm environmental signals. Non-host series were re-scaled to approximately the same variance of the host series by taking the product of each yearly non-host index value and a ratio of standard deviations (standard deviation of non-host series divided by standard deviation of host series). The re-scaled non-host indices were then subtracted from the host indices (see Swetnam *et al.* [1985] for equations). If host and non-host trees were responding similarly to climate, then the differences between the two chronologies (called "corrected indices") preserve the variation due primarily to the effects of budworm defoliation or other non-climatic environmental variations. Comparison of the corrected series during a "modern" period with independent records of insect outbreaks was an important step in this procedure. This comparison provided a test of the assumption that the corrected series contained mainly a budworm outbreak signal.

We compared the corrected index series with twentieth century forestry records (e.g., forest entomology reports, aerial surveys (misc. reports on file at USDA Forest Service Southwestern Region Office, Albuquerque, NM). Low growth periods in the corrected series corresponding to outbreaks were the basis for criteria used to identify outbreaks in the period preceding forestry records. These criteria were: periods in the corrected series during which the indices were less than expected growth (1.0) for 3 or more consecutive years, and the lowest growth value during this period was greater than 1.28 standard deviations below the mean of the series. These criteria emphasize periods of persistent and high magnitude negative differences between host and non-host chronologies.

Budworm defoliation effects on radial growth generally differ from effects due to other environmental disturbances in the tree-to-tree synchrony, duration and intensity of the response. The initial and terminal growth reduction years caused by defoliation often differ by one to a few years among trees in a stand. Growth responses due to drought tend to be synchronized between trees within and among stands, with some effect evident in all species. Outbreaks of other defoliators in northern New Mexico last fewer years than budworm out-

breaks, which usually last 5 to 20 years (Perry 1925, Lessard 1975). *Orgyia pseudotsugata* McDonnough and *Epinotia meritana* Heinrich in northern New Mexico are typically limited to short-term local infestations with white fir as the principal host (Furniss and Carolin 1976, Wickman 1980, Wickman *et al.* 1971). Bark beetle effects also differ. *Dendroctonus pseudotsugae* Hopkins does not attack white fir and is usually fatal, and *Scolytus ventralis* LeConte usually does not attack Douglas-fir (Furniss and Carolin 1977). Both bark beetles are sometimes secondary pests after budworm defoliation.

Results

While sampling within the stands we noted that host trees often displayed evidence of past budworm outbreaks with the presence of "spike" (dead) tops. Topkilling is a well known effect of budworm defoliation (Ferrell and Scharpf 1982, MacLean 1985). Some older trees had as many as three or four old spike tops with crooked stems just below the weathered spikes, indicative of a new terminal leader that assumed apical dominance following each outbreak. Examples of ring patterns visible in cores from such trees are shown in Fig. 2. While core samples from many trees showed multiple periods of obvious budworm-caused reduced growth (Fig. 2), the effects were more subtle in other trees. Identification of probable budworm-caused reduction in these cases required careful comparison with non-host chronologies, followed by the correction (subtraction) procedure.

Forestry and Tree-Ring Records

Comparison of outbreak timing recorded in the tree-ring series and forestry documents confirmed that the ring series were good indicators of past outbreaks. The forestry records extended back to 1924 and for the early period (1924-1960) consisted primarily of annual forest pest and disease condition reports. These documents typically summarized annual observations of insect activity on each National Forest. The early 1920s reports described severe defoliation in large areas of the Carson and Santa Fe National Forests. The Jemez chronologies clearly revealed this outbreak beginning in the late 1910s and persisting into the early 1920s (Fig 3). This outbreak also occurred on the Questa district, with variable timing in these stands

between 1910 and 1930 (Fig 4). Apparently, this outbreak did not spread to the Taos district (Fig. 5).

An extensive outbreak in the mid 1940s to early or mid 1950s was also noted in the forestry documents in several of our sampled watersheds (e.g., Rio Pueblo and Rio Vallecitos - the Alamitos and Policarpio areas were specifically mentioned). The Jemez stands also recorded this outbreak. In many stands this outbreak appeared as two major phases of growth reduction - the first in the mid 1940s and the second in the early to mid 1950s. This was consistent with the forestry documents which refer to severe defoliation in many areas of the two National Forests in 1944 or 1945, some abatement of defoliation in the late 1940s, then a resurgence of defoliation from about 1950 to 1953. Localized defoliation was also reported in the early years of the 1960s in some districts, particularly the Camino Real (formerly the Peñasco district, especially the Rio Pueblo watershed).

The most recent outbreak was the best documented. Maps of defoliation estimates from aerial and ground surveys were available for most of the sampled stands. Correspondence between these records and the tree-ring measurements was quite good with ring growth reduction beginning in the same year of first observed defoliation, or lagged by one year. For example, growth reductions were obvious in stands from the Cabresto and Red River watersheds by 1981. Heavy defoliation (greater than 66% of needles lost) was recorded in this watershed in 1980. The Rio Pueblo stands did not show growth reduction until 1985 or later. Annual aerial and ground survey maps from the 1980s clearly show that this outbreak spread eastward up this watershed, with first detection of defoliation in this watershed in 1985.

Regional-Scale Outbreak Patterns

The corrected chronologies exhibited variable patterns of both synchrony and asynchrony of budworm outbreaks within the region (Figs. 3 and 4). A summary of outbreak timing among all the stands sorted by ranger district is shown in Fig. 5. This summary graph reveals

that major regional-scale episodes[1] of increased budworm activity occurred during the past three centuries. Widespread outbreaks were recorded in all three districts in most of the major episodes. Exceptions were a brief episode in the late 1850s to early 1860s on the Jemez and Camino Real districts, and the 1940s-1960 episode when only two sampled stands on the Questa district showed tree-ring evidence of defoliation (Fig 4). Forestry documents did not specifically mention budworm activity on this district during this period.

Our earlier compilation of outbreak chronologies from both Colorado and New Mexico showed an increase in synchrony of outbreaks among stands during the late twentieth century. This was manifest as a relatively close temporal clustering of minimum growth years during outbreaks in the 1940s and 1980s as compared to earlier outbreaks. The enlarged data set from New Mexico does not clearly exhibit this pattern (Fig. 5). The larger numbers of stands recording outbreaks in plotted five-year increments during the last two outbreak episodes was at least partly a function of a maximum sample size (numbers of stands) included in the data set during this period.

Ten to 35-year episodes of increased budworm activity were temporally interspersed with periods of reduced activity lasting from five to twenty years (see minimum growth years in Fig. 5). This pattern was especially evident for outbreaks since late 1800s. Some of the episodes (e.g., 1870s-1890s, 1940s-1960s) show a pattern of high activity, decline, and then resurgence. This pattern was also apparent in descriptions of outbreak intensity and extent in forestry documents for the 1940s-1960s period. The longest interval between minimum growth years of outbreaks (about 20 years at most sites) occurred from approximately 1925 to 1945. The compilation of initial years of outbreaks (Fig. 5) also showed temporal clustering of outbreak occurrences across the region, but intervals with no new outbreaks beginning were shorter. This points out a general observation also contained in the forest entomology reports: Western spruce budworm has been a chronic pest in the Southern Rockies, with some defolia-

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1. Here and elsewhere in the text the term "episodes" referes to a temporal grouping of budworm outbreaks.

tion taking place somewhere in the region nearly every year.

A long episode of regional budworm activity extended from the late 1700s through the early 1800s. Activity during this approximate 60 year period seems to have waned during the 1810s, then resurged during the late 1820s and 1830s. At individual sites this episode was often characterized by two or three outbreaks lasting from 5 to 15 years separated by only a few years with radial growth at or above the expected growth level.

Sample depth (total number of chronologies in the data set) declines steadily before the mid 1800s, so confidence in observation of regional patterns also decreases. Nevertheless, clustering of minimum growth years during inferred outbreaks back through the early 1700s and late 1600s (Fig. 5) indicates that episodic, regional-scale budworm outbreaks, interspersed with more quiescent periods, has been a common spatio-temporal pattern for at least three centuries.

Duration and intensity of outbreaks since 1690 are summarized in Table 2. The identified episodes differ slightly from those we identified in our earlier work (Swetnam and Lynch 1989). No clear change in duration or intensity of outbreaks during the past three centuries (until about 1970) was evident (Tab. 2). The most recent episode was computed as the shortest, but it is not comparable to the other episodes because active defoliation was taking place in many of the stands during the sampling. This episode, however, does show the greatest growth reduction among all identified episodes.

An Exceptionally Long Budworm Outbreak Chronology

The Rito Claro stand (number 13) in the Cabresto watershed contained many very old Douglas-firs. The oldest tree sampled at this site had a pith date of 1210 A.D. From a total of 64 trees sampled at this site, four trees had inner ring dates before 1230, and ten trees had inner ring dates before 1300. To the best of our knowledge this site contains the oldest living Douglas-fir trees that have been sampled in New Mexico.

After we recognized that the Rito Claro stand contained very ancient trees we began to search the Cabresto and adjacent Red River watersheds for suitable pine sites to serve as a

climatic control. We found two pure stands of limber pine (Italian Canyon, stand P5 and Elephant Rock, stand P7) with even older trees than the Rito Claro stand! Many trees at these sites exceeded 900 years in age and the oldest living tree had an inner ring date of approximately 320 AD (near pith, ring count only before 1050 because crossdating was poor). Tree rings in remnant logs on the surface date back at least to 93 AD. These sites contain the oldest known living trees in New Mexico, and the tree-ring chronologies are among the longest in the Southwestern U. S., exceeded only by bristlecone pine chronologies from the San Francisco Peaks in Arizona, and chronologies from the four corners region derived from ancient timbers contained in ruins.

Figure 6 shows the corrected Douglas-fir chronology from Rito Claro. This chronology was corrected using the Italian Canyon limber pine series. The two series had a Pearson correlation coefficient of 0.803 ($p<0.001$), indicating that they shared a substantial common year-to-year variance. The corrected series, however, reveals that the longer-term variations in the two series diverged during many periods (Fig. 6). We infer that the larger negative departure periods were due to budworm outbreaks. A total of 20 outbreaks were identified; twelve of them occurred during the first half of the series (1210 to 1600) and eight during the second half (1601-1989). Duration of outbreaks during the earlier part of the record tended to be relatively short (5 to 10 years), especially during the period from about 1360 to 1520. Outbreaks since 1600 lasted from about 10 to 30 years.

The most recent outbreak shows the lowest growth reduction year for the whole series in 1986 (an index value of 0.0), when many of the trees at the site did not form an annual ring in the lower bole. The last year of this series (1989) shows a recovery to just above expected growth (index value of 1.025).

Positive departures were almost as frequent as the negative departures in the Rito Claro and other site chronologies (Figs. 6, 3 and 4). It is likely that these variations were largely due to growth release of sampled trees (survivors) following the outbreaks as a result of reduced competition (from killed trees) and perhaps an influx of nutrients via insect frass. This effect has

been noted by several other researchers in other regions under different insect defoliation regimes (e.g., Wickman 1980, Alfaro *et al.* 1982, Carlson and McCaughey 1982, Carlson *et al.* 1989). Notice that the growth release effect is visually obvious for several outbreaks on the core samples shown in Figure 2.

While it was surprising that a living stand of trees sustained so many outbreaks during its lifetime (at least 20) other observations support the more general inference that this stand has been subject to chronic stress from repeated outbreaks. Although the Rito Claro site was not particularly dry or otherwise obviously harsh (elevation is 2870 m), the average DBH for 700+ year old trees was only 44.4 cm. The ring series often showed periods of extreme growth suppression followed by surges of increased growth. Many of these trees had multiple old spike tops on their stems, suggesting repeated topkilling by budworm. We believe this stand represents an unusual case of a relatively stable episodic budworm outbreak regime that persisted for centuries. It was stable in the sense that outbreaks were not so severe as to kill off very large proportions of the stand, nor have killed trees provided a fuels condition leading to stand replacing fires.

Interestingly, the Rito Claro stand has one of the highest stocking densities among the sampled stands, and it has the largest proportion of Douglas-fir relative to white fir (Tab. 1). Much of the density is due to smaller diameter stems that have probably established since fire suppression began about 80 years ago. Dominance by the Douglas-fir may be due to the long-term selective pressure against white fir by budworm, since true firs are generally preferred hosts and tend to sustain greater growth reduction and mortality (Williams 1967, Carlson *et al.* 1983, Swetnam 1987b).

This effect was noted many years ago by W. J. Perry (1925), a Forest Service man working in northern New Mexico. He argued that, from a forester's point of view, budworm outbreaks may not be so bad: *"Without Harmologa [sic] our Douglas fir type of country grows up to a perfect jungle with the white fir predominating...Also he has been here before and we still have some forests, and under the conditions of the Southwest, the writer considers him not*

at all an unmixed evil. In fact, were it not that he inevitably sets up an awful fire trap every time he visits us, the writer believes his activities result in more good than harm in our mixed Douglas fir-white fir stands of timber. I am sure but that we should assume the extra risk and thank him for coming, at least so long as we handle our forests on a sawlog and not a pulpwood basis."

Discussion and Conclusions

Our compilation of tree-ring records from northern New Mexico show that budworm outbreaks have recurred for at least eight centuries. Outbreaks were typically widespread within the region. No clear change in frequency or duration of occurrence at the regional-scale was evident. This finding is in accord with our earlier observations (Swetnam and Lynch 1989), but is in contrast to the findings of Anderson *et al.* in the northern Rockies. They identified an increase in duration of budworm outbreaks since about 1910 relative to the period from 1814-1910.

A lack of measurable changes in outbreak frequency or duration may be partly due to spatial and temporal variability of the record, and the long-term nature of outbreaks. Budworm history was variable both in duration of major episodes (about 10 to 60 years) and in the length of intervals between episodes (about 5 to 20 years). Because outbreaks were multi-decadal in length, the two to three century-long chronologies from most stands may not be long enough to fully assess slowly changing outbreak patterns. The 790 year chronology from Rito Claro showed no obvious change in outbreak regimes since at least 1600 A.D. This stand, however, was certainly unusual in terms of its longevity and may it not be representative of regional-scale patterns in the pre-1700 period.

The dendrochronological record of budworm history has other limitations. We believe the most important are: (1) Tree-ring series were from surviving trees, so the radial growth impacts on trees that were killed during past outbreaks was not reflected in the growth reduction estimates. Thus, our record of growth impacts is an underestimate. (2) The sample sizes within and among the stands decreases with time before present. Thus, temporal comparisons

of outbreak regimes must consider possible biases. (3) The corrected index chronologies probably contain some variations due to non-budworm sources. This is because the non-host chronologies were not perfect "climatic controls" for variations in the host chronologies. Other disturbances, such as fires, may have differentially affected the host and non-host sites.

Despite these data limitations, a couple of observations suggest that a change in the budworm regime has occurred: (1) The twentieth century record contained the longest interval of reduced budworm activity - about 20 years between lowest growth years among most sites (from 1925 to 1945). (2) The recent outbreak (1970s-1980s) resulted in the largest mean growth reduction. This result was similar to our earlier findings (Swetnam and Lynch 1989), i.e., the 1980s outbreak was unusually severe. The data limitations listed above were not likely to have resulted in these observations. Actually, their effect would generally be expected to counter these patterns. Most of the trees we sampled were still quite vigorous (full crowns, etc.) so most are likely to survive the latest outbreak. Decreasing sample depth with time before present would be expected to introduce longer intervals in the past than in the present, since fewer stands were included in earlier and earlier portions of the record.

The total amount of area defoliated in northern New Mexico has decreased substantially in recent years, but the historical pattern of outbreak resurgence suggests that the current episode may only be in a relatively quiescent period. Only a few of the stands where budworm defoliation had decreased were showing radial growth recovery to expected levels in the last years of the chronologies (1986 to 1989). Given the shortness of the reduced growth period relative to long-term historical patterns (means of 6.5 years versus 8 to 13.6 years duration for other episodes, Table 2), a resurgence of regional-scale defoliation in northern New Mexico might be expected in the 1990s.

A difference between our expanded set observations presented here and those from the 10 chronologies we complied for the Southern Rockies of Colorado and New Mexico (Swetnam and Lynch 1989) was the record of a major outbreak in the 1900s-1920s. An outbreak during this period was recorded in only a few of the earlier sampled stands, and as a result the tempo-

ral distribution of outbreaks along our transect from the Colorado Front Ranges to the Sangre de Cristo Mountains showed an even longer gap during the early twentieth century. Our interpretation was that Southern Rockies mixed-conifer forests were in a highly transitive state during the early 20th century. Extensive logging and fires in the previous decades of the settlement era had reduced forest density. Subsequent favorable climate (Schulman 1956, Rose *et al.* 1981) and other conditions (e.g., reduced sheep grazing in the 1920s [Carlson 1969, Baker *et al.* 1988]) allowed many host tree seedlings to become established. During the first half of the century stands were less susceptible or vulnerable to outbreaks because of the open conditions, and because of more vigorous growth by surviving overstory trees and young seedlings and saplings. By the 1940s the mixed-conifer forests were more closed with multiple canopy layers dominated by host species. Thus, budworm outbreaks during the later half of the 20th century have been more widespread and intense than earlier periods.

Based on our current larger but more spatially concentrated chronology set we conclude that the above historical explanation remains tenable. However, the occurrence of the 1900s-1920s outbreak in the new chronologies from northern New Mexico appears to represent an exception to the generalization that forests were in transition and less prone to outbreaks during this period. The most synchronous and intense record of this outbreak was in the Jemez stands (Fig. 3, 5). One explanation may be that the Jemez Mountains were not as affected by the intensive logging and fires of the settlement era as the forests of the Front Ranges or the Sangre de Cristo Mountains. If so, the relatively undisturbed Jemez mixed-conifer forests would have had greater canopy closure than the harvested forests to the east, and therefore greater susceptibility to an outbreak.

From the historical record it is clear that the Front Ranges and Sangre de Cristo Mountains were much more exploited during the 19th century than the Jemez. For example, logging for railroad ties, mine timbers, and other building lumber was extensive in the Front Ranges during the late 1800s and around the turn of the century (Veblen and Lorenz 1986). Very extensive cutting for railroad ties took place on the Camino Real district during the 1910s and early

1920s (Korstian 1914, Cook 1954, DeBuys 1985). Some logging on the periphery of the Jemez Mountains began in the late 1890s, but cutting in the interior where our sampled stands were located was not extensive until the 1930s or later (Allen 1989).

Outbreaks, Climatic Variation and Other Potential Uses

An important potential use of budworm outbreak histories is the study of climate-disturbance interactions. This topic has been emphasized as particularly important in recent global climate change plans (e.g., NRC 1990, ICSU 1990) because the response of forest ecosystems to climate change may be primarily driven by climate-linked disturbances such as fires and insect outbreaks.

In a study of spatial and temporal patterns of western spruce budworm outbreaks Kemp *et al.* 1985 showed that frequency of outbreaks in the Pacific northwest were associated with low annual precipitation, low mean maximum temperatures for the month of January, and low July mean minimum temperatures. Following this lead we made a comparison of a tree-ring based reconstruction of annual precipitation for the area around Santa Fe, New Mexico (Rose *et al.* 1981) with our budworm outbreak chronologies (Fig. 6). No obvious pattern of association between the extrema of dry and wet periods and outbreak episodes are apparent.

Although these results were negative, other climatic analyses involving parameters more important to budworm populations may be more fruitful. For example, tree-ring reconstructions of drought severity indices, which include both temperature and precipitation variables, might be used in a comparative study of past outbreak regimes. Seasonal temperatures and extreme events (such as spring or summer frosts) have also been identified as important factors affecting budworm populations. Reconstructions of temperature variables using tree species growing at higher elevations, such as bristlecone and limber pine, is possible (Fritts 1976). In order to maintain independence, an important restriction for such reconstructions would be that the dendroclimatic sites were free of direct interactions with budworm outbreaks (e.g., Douglas-fir growing in a mixed-conifer stand). The Santa Fe precipitation reconstruction met this criteria; only piñon and ponderosa pine chronologies from lower forest border stands were used (Rose

et al. 1981).

Another potential use of tree-ring based reconstructions of budworm history is the study of budworm population dynamics. This field has a rich literature of theoretical research (particularly for *C. fumiferana*, e.g., Royama 1984, Ludwig *et al.* 1978), but empirical work has relied on temporal data extending back only one cycle of a budworm outbreak or less (e.g., Morris 1963). We suggest that our corrected tree-ring chronologies are a "noisy" proxy of budworm population density within sampled stands. Additional study of simultaneous budworm population and tree-ring measurements within active outbreak areas is needed to test this assertion. In any case, time series analysis, including studies of the non-linear properties (sensu Schaffer 1985, Sugihara and May 1990) of the budworm-tree-ring chronologies, may reveal new and fundamental insights into the budworm-forest dynamic.

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Table 1. Stand descriptions.

Site Name	Aspect (d)	Slope (%)	Elev. (m)	Habitat Type	Stocking Density sq m/ha	Stocking Density #/ha	Relative Importance (% by stocking) PSME	ABCO	ABLA	PIEN	PIPU	PIPO	PIFL	POTR	<1%
Jemez River watershed															
1 Peralta West	325-030	20-50	2720	ABCO/ACGA	65.0	629	41	24		1	10	7	4	19	ACGL
2 Peralta High	10	30-60	2790	ABCO/VAMY	55.5	649	23	18		38	4	<1	2	14	ACGL
3 West Vallecitos	30	40-60	2510	ABCO/QUGA	26.5	612	30	20				49			
4 Los Griegos High	345	50-60	2930	ABCO/ACGA	44.8	783	82	1		1				15	
5 Los Griegos Low	345	10-50	2870	ABCO/ACGA	18.4	431	50	6						8	
6 Fenton Lake	340-360	40-50	2500	ABCO/ACGA	41.1	834	86	4				6	1	1	
7 East Fork	340-360	40-50	2580	PIPU/LIBO	50.3	765	67	6		1	16	3	1	7	
8 Lower East Fork	350-010	45-50	2410	PIPU/EREX	51.7	715	42	38			8	12			QUGA
9 Barley Ridge	flat	flat	2610	ABCO/QUGA	15.5	216	25	30				17	6	3	
P1 Baca	150-180	50-60	2450	n.d.											
P2 Fenton Lake	140-160	20-50	2750	n.d.											
P3 Abouselman Spring	180	60-80	2600	n.d.											
P4 Cat Mesa	130	5-50	2530	n.d.											
Rio Grande watershed															
10 Frijoles Canyon	230	10-20	2730	ABCO/QUGA	73.3	1052	46	28				19	6	7	
Cabresto Creek watershed															
11 Bonita Canyon	300-360	10-43	2780	ABLA/VAMY	29.6	685	62	1	7	20	4			6	
12 Singing River	300-040	50-70	2710	ABCO/SYOR	35.8	947	16	71				4	8		
13 Rito Claro	110-190	10-30	2870	ABCO/ARUV	51.5	1811	85	8		2			3	7	
14 Cabresto Canyon	360	20	2500	n.d.	17.6	379	75	7	1		16	1		1	
P5 Italian Canyon	180-220	50-80	2870	n.d.											
P6 Cabresto pinyon	200-220	40-70	2550	n.d.											
Red River watershed															
15 Fawn Lakes	010-020	20-80	2850	ABCO/ARUV	22.5	449	65	13				2	1	3	
16 Red River	350-050	40-65	2770	ABCO/ARUV	34.4	932	45	46		1	1	1	1	5	
P7 Elephant Rock	180-200	10-50	2600	n.d.											
Rio Vallecitos watershed															
17 Burned Mountain	270	10	2710	n.d.	24.1	501	85	8		7					
P8 Burned Mountain Pine	30	flat	2710	n.d.											
Rio Pueblo watershed															
18 Policarpio Canyon	140-190	50-85	2760	PIPU/EREX	36.9	396	73	10		11	1	5			PIAR
19 Flechado Canyon	100-150	10-30	2740	ABCO/VAMY	34.8	665	59	26				2		12	
20 Alamitos	320-040	1-15	3050	ABCO/VAMY	60.5	467	86	6		2			1	6	
21 La Junta	120-190	30-60	2730	ABCO/QUGA	22.2	143	35	8			1	49	6		PIAR
P9 Rio Pueblo	220-280	30-80	2480	n.d.											
P10 Boca de la Junta	160-190	50-70	2700	n.d.											
Rio de Taos watershed															
22 Capulin Canyon	90	5	2900	n.d.	15.7	176	29	12				59	1		
23 Garcia Park	225	20	2880	n.d.	28.6	599	73	3				24			
P11 Capulin Canyon Pine	90	5	2900	n.d.											
P12 Gracia Park Pine	225	20	2880	n.d.											
Coyote Creek watershed															
24 Osha Mountain	90	5	3050	n.d.	21.2	538	56	11	4	23		6			
P13 Osha Mtn. Pine	90	5	3050	n.d.											

Footnotes for Table 1:

Stand numbers are referenced to the map in Figure 1. Pine stands are listed with a "P" before the stand number.

Habitat types are described by Moir and Ludwig (1979) and Develice *et al.* (1986). "n.d." indicates that habitat type was not determined.

Species abreviations are : ABCO = *Abies concolor*, ABLA = *Abies lasiocarpa*, PIEN = *Picea engelmannii*, PIPU = *Picea pungens*, PIPO = *Pinus ponderosa*, PIFL = *Pinus flexilis*, POTR = *Populus tremuloides*, PIAR = *Pinus aristada*, ACGL = *Acer glabrum*, LIBO = *Linnaea borealis*, VAMY = *Vaccinium myrtillus*, QUGA = *Quercus gambelii*, EREX = *Erigeron eximius*, SYOR = *Symphoricarpus oreophilus*, ARUV = *Arctostaphylos uva-ursi*.

Table 2. Duration and severity of budworm outbreaks during major oubreak episodes.

Period	Duration (yrs.) Mean	STD	Maximum Growth Reduction (%) Mean	STD
1690s-1730s	8.0	4.3	65.8	17.7
1740s-1780s	11.1	7.0	61.6	16.5
1790s-1840s	13.0	10.1	54.8	17.5
1850s-1860s	12.8	4.9	48.0	9.9
1870s-1890s	13.6	4.6	52.3	15.6
1900s-1920s	13.4	9.6	56.1	21.9
1940s-1960s	11.2	5.9	52.3	15.7
1970s-1980s	6.5	2.7	73.1	21.2

Figure Captions

Fig. 1. Map of the north central region of New Mexico, United States. Sampled stands are clustered in the Jemez Mountains, southwest of Los Alamos, and in the Sangre de Cristo Mountains, north and south of Taos. Mixed-conifer stands are shown with soild dots and pine sites are open circles. The numbers refer to stand descriptions in Table 1.

Fig. 2. Increment cores from four trees showing obvious periods of pronounced and sustained growth reductions due to defoliation of the trees by western spruce budworms. Several of these trees also had one or more old spike tops caused by the past defoliation events. Growth releases are also obvious following several of the reduced growth periods.

Fig. 3. Corrected tree-ring index chronologies from the Jemez Mountains. Low pass filtered (smoothed) index values are shown, which emphasize the longer-term variations in the chronologies. The continuous lines are the Douglas-fir chronologies and the dashed lines are the white fir chronologies. The vertical dotted lines are approximately aligned with outbreaks (growth periods below the mean lines) that are generally in synchrony among the stands. The most recent outbreak does not show on the plots for some of these series because the last six years containing the lowest index values were truncated when the filter was applied.

Fig. 4. Corrected tree-ring index chronologies from the Sangre de Cristo Mountains. The upper five plots are from stands located on the Questa ranger district north of Taos and the lower four plots are from stands on Camino Real ranger district. Chronologies from other stands sampled in our previous study (Swetnam and Lynch 1989) are not shown.

Fig. 5. Summary of western spruce budworm outbreak timing among 24 mixed-conifer stands in northern New Mexico. Clustering of dates (bars), reflecting synchrony of outbreaks in the

region, is especially obvious for minimum growth years during outbreaks (lower plot). Number of chronologies in the data set are shown by the line graph (lower plot).

Fig. 6. Corrected tree-ring index chronology from the Rito Claro stand (1210-1989). Vertical arrows show occurrence of the most pronounced and persistent reduced growth periods inferred to be past outbreaks. Black bars show timing of extreme drought and wet periods (from 1210 to 1970), and major outbreak episodes recorded by all chronologies. The drought and wet periods were derived from a tree-ring reconstruction of annual precipitation at Santa Fe (Rose *et al.* 1981). The drought and wet periods were identified as years with precipitation values above or below two standard deviations of the mean, plus the preceding and subsequent years that were above or below the mean (respectively).

Fig 1

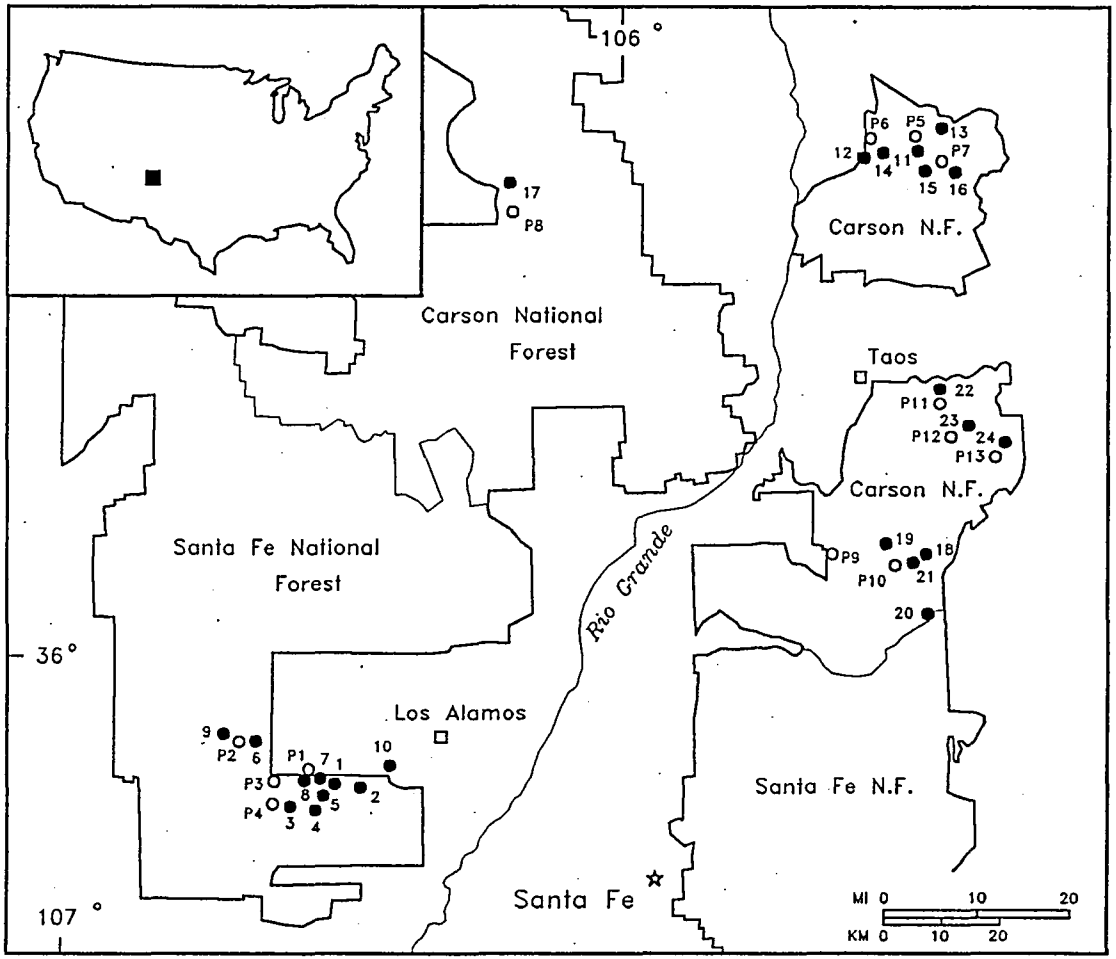

106 °
17
P8
P6
P5
13
12
11
P7
14
15
16
Carson N.F.
Carson National
Forest
Taos
P11
22
23
P12
24
P13
Carson N.F.
Santa Fe National
Forest
Rio Grande
P9
19
18
P10
21
20
36°
Los Alamos
9
P2
6
P1
7
1
10
P3
8
5
2
P4
3
4
Santa Fe N.F.
Santa Fe
107 °
MI 0 10 20
KM 0 10 20

Fig 2

Fig. 3

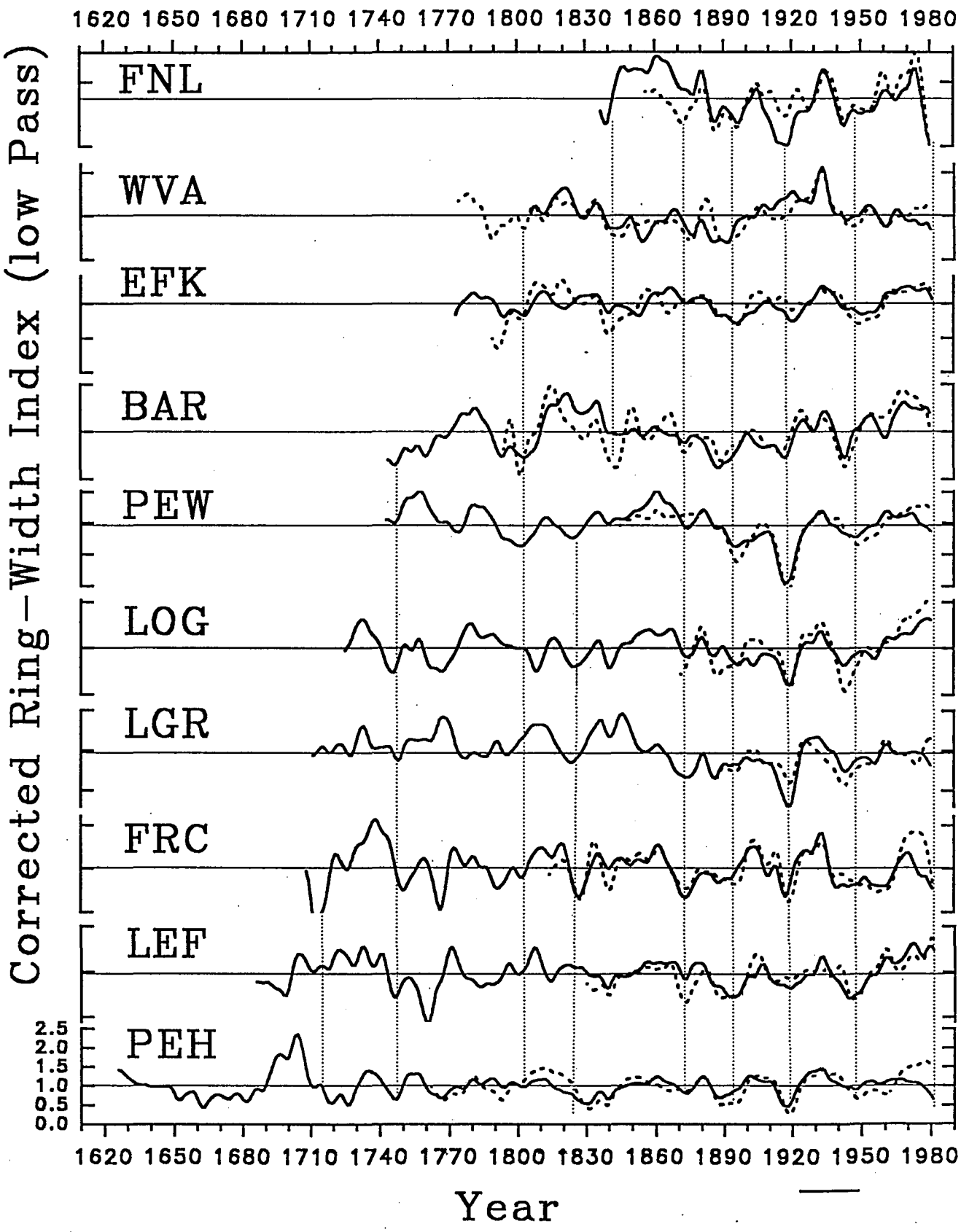

1620 1650 1680 1710 1740 1770 1800 1830 1860 1890 1920 1950 1980
FNL
WVA
EFK
BAR
PEW
LOG
LGR
FRC
LEF
PEH
Corrected Ring-Width Index (low Pass)
2.5
2.0
1.5
1.0
0.5
0.0
1620 1650 1680 1710 1740 1770 1800 1830 1860 1890 1920 1950 1980
Year

Fig 4

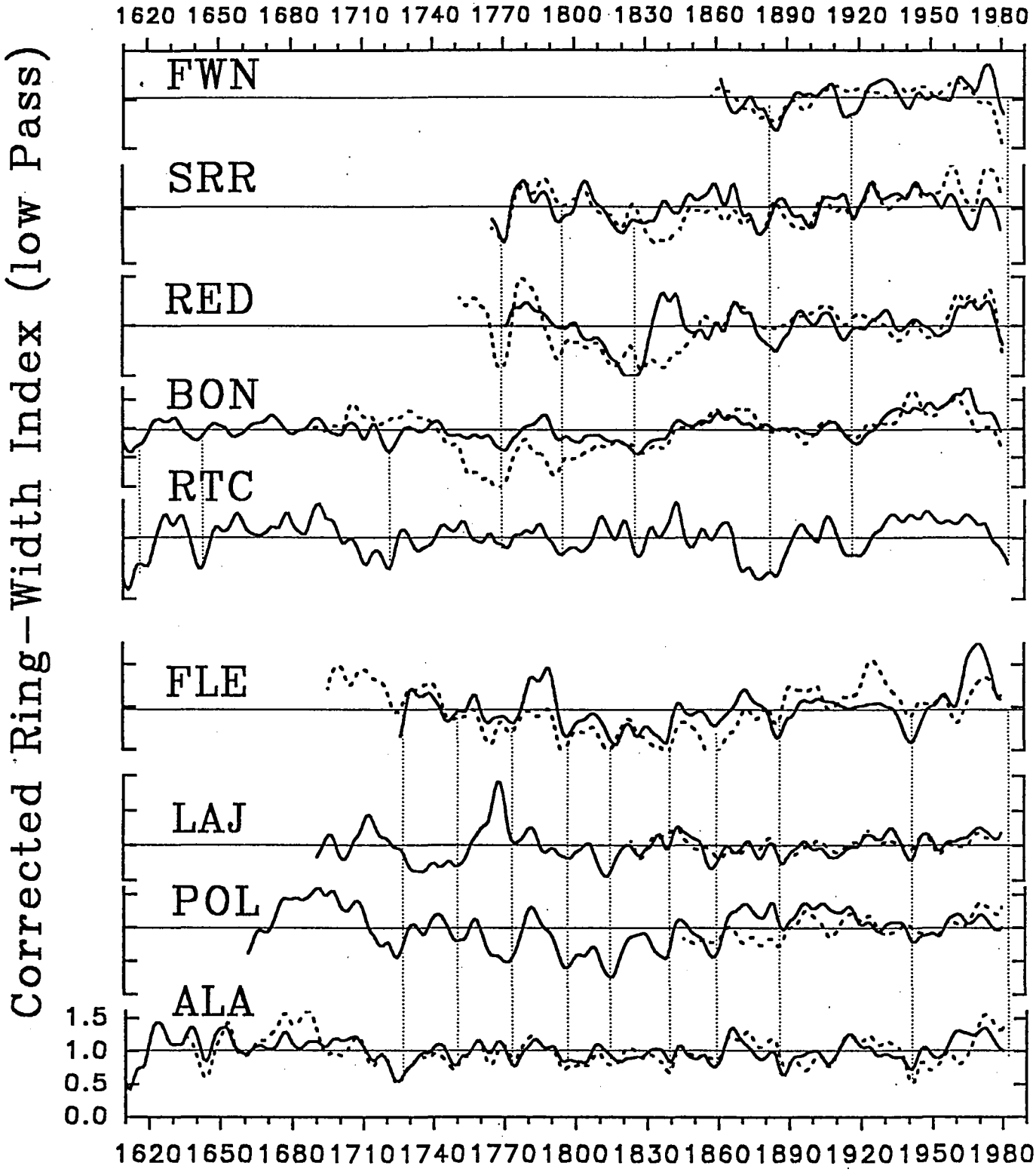

1620 1650 1680 1710 1740 1770 1800 1830 1860 1890 1920 1950 1980
FWN
SRR
RED
BON
RTC
FLE
LAJ
POL
ALA
Corrected Ring-Width Index (low Pass)
1.5
1.0
0.5
0.0
1620 1650 1680 1710 1740 1770 1800 1830 1860 1890 1920 1950 1980

Fig 5

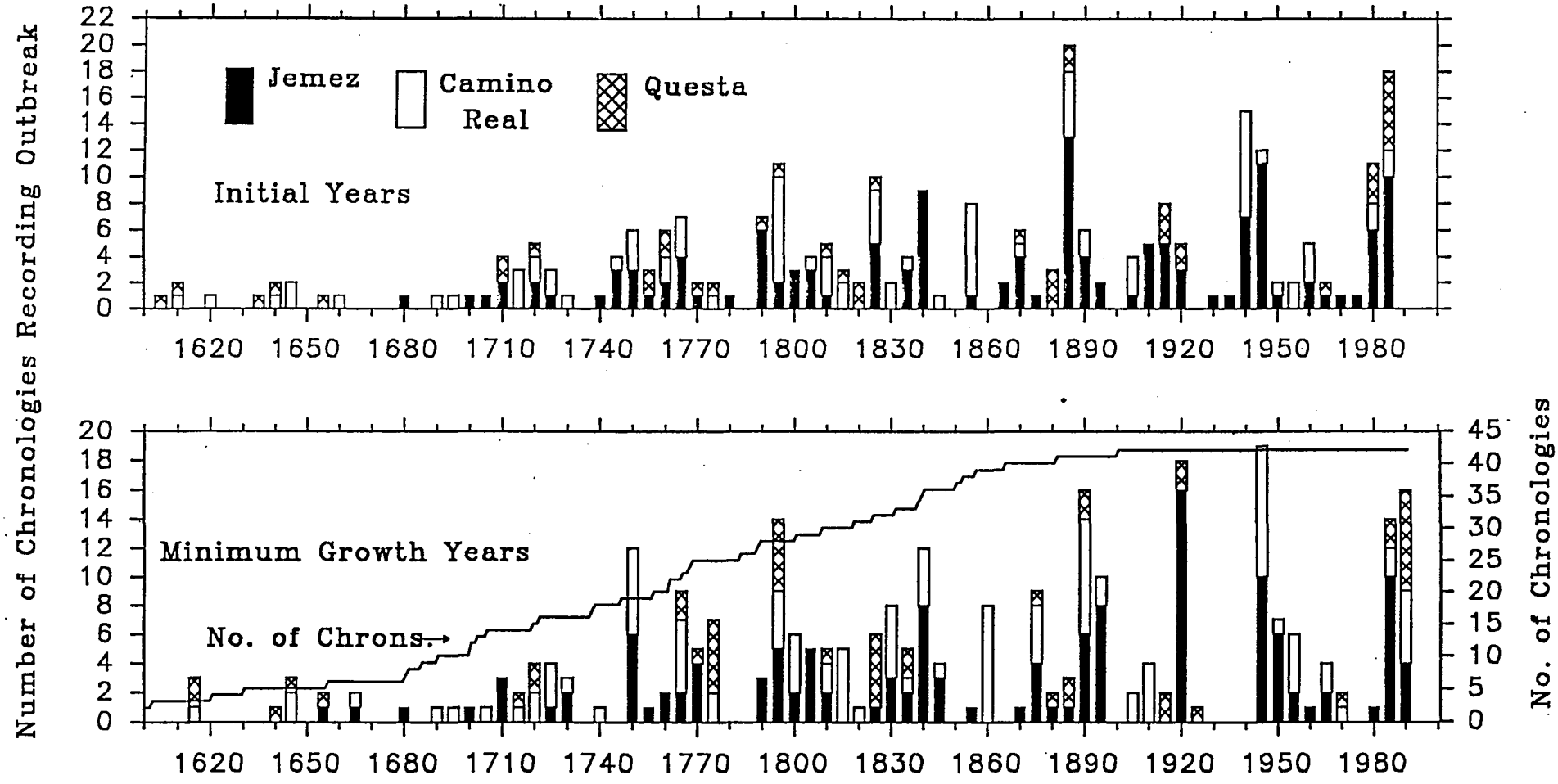
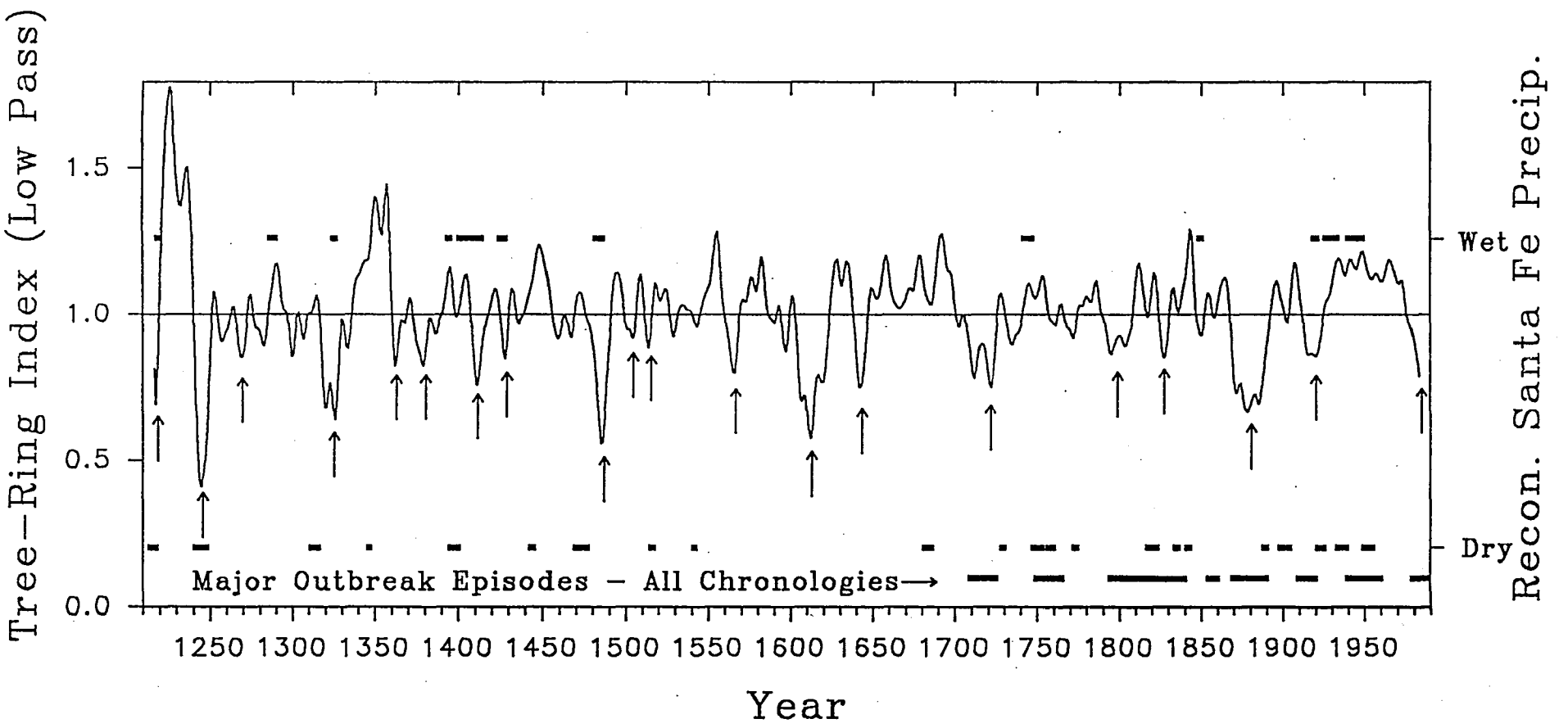

Jemez
Camino Real
Questa
Initial Years
Minimum Growth Years
No. of Chrons.→
Number of Chronologies Recording Outbreak
No. of Chronologies
22
20
18
16
14
12
10
8
6
4
2
0
45
40
35
30
25
20
15
10
5
1620
1650
1680
1710
1740
1770
1800
1830
1860
1890
1920
1950
1980

Fig 6


Tree-Ring Index (Low Pass)
1.5
1.0
0.5
0.0
Wet
Dry
Recon. Santa Fe Precip.
Major Outbreak Episodes – All Chronologies→
1250 1300 1350 1400 1450 1500 1550 1600 1650 1700 1750 1800 1850 1900 1950
Year

APPENDIX D

Data Files on Floppy Disk

File names and contents are:

"**ALLNEW.WQI**" = contains chronology listings of all standard ring-width index chronologies of Douglas-fir and white fir collections. Column headings contain 3-letter codes for site names and and postscript "DF" or "WF" for Douglas-fir and white fir respectively.

"**ALLNEWC1.WQ1**" = contains chronology listings for all corrected ring-width index chronologies for Douglas-fir and white fir. Column headings are same as in ALLNEW.WQ1.

"**RTC.WQ1**" = contains full length of Rito claro Douglas-fir chronologies, standard and corrected, back to 1211 A.D.

"**EREITC.WQ1**" = contains standard ring-width index chronologies from limber pine at Elephant Rock (ERE) and Italian Canyon (ITC).

"**NMPINES1.WQ!**" = contains eleven other pine ring-width index chronologies chronologies developed in this project. Column headings are 3-letter codes asigned to each site.